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JANUARY, 1947

Vol. VIII. No. 1.

WOOL—HOME PRODUCTION TO MEET HOME REQUIREMENTS

THE total annual production of wool in India is estimated to be about 85 million lb., of which a little over half is used in the country ; the rest, as well as the wool imported by overland routes, totalling in all about 46 million lb. is exported. It appears, therefore, that the consumption of wool in India is limited in amount and much more is produced than can ever be used in the country. That is true, however, only in so far as it applies to the particular quality of wool : fortunately that quality is relatively poor and, being fit in the main only for the manufacture of coarse material, its value is but a fraction of that of the fine and super-fine wool grown in some other countries. For that reason, if for no other, it is regrettable that India's requirements of flannels, super-fine broad cloth, light weight mixtures and other like material must be imported either in the shape of the finished article or as merino and crossbred wools. At present some 14½ million lb. of wool of this description is imported in one form or another, and the amount is likely to continue to rise as the standard of living rises, but, because of climatic conditions, home consumption per head will never reach the height attained in countries less favoured by the sun.

While the world's annual production of wool is 4,000 million lb., there is a store left from the wartime British procurement activity of 6,000 million lb. which it is proposed to dispose of over the next 12 to 14 years through the Empire Central Wool Committee. Australia produces something more than 1,000 million lb. annually all of which is fine or super-fine wool, and, in spite of the manufacture of artificial fibre, she looks forward to an ever greater sale. Against this, the amount India produces appears to be trifling and, especially so, when it is realized that all her exports are classed as East Indian carpet wool and fetches just about half the price that merino wool does. There appears to be no technical reason why India should not share the lucrative world market in fine wool now so dominantly in the hands of Australia, or, if under the present conditions that aim be thought too ambitious, there appears to be no reason, technical or otherwise, why the home market for fine and crossbred wool should not be completely supplied from indigenous sources.

Wool is used in India by the traditional hand-spinning and handloom weaving industry or by manufacture on power looms. The hand method has been used for centuries in the making of articles of such diverse quality as coarse blankets, carpets, and Kashmir shawls. A power mill was installed at Cawnpore 70 years ago where the finer qualities of indigenous wool were used for the making of coarse blankets and other like articles and later the manufacture of finer woollen goods. Somewhat later still, mills were started at Amritsar primarily for spinning carpet yarns to supply the requirements of the cottage carpet industry. Two or three other mills were also erected in other parts of the country, all at first mainly for the purpose of utilizing home-grown wools until the demand from richer urban areas for fine quality cloths induced them to use a certain amount of Australian merino wool. During the 1914-18 war, the industry was stimulated into greater activity mainly for the production

of warm army clothing and after that war, on reversion to a peacetime footing, private capital was invested freely in the manufacture of woollen and worsted fabrics to supply the neglected civilian market. These factories had, however, soon to put up a stiff fight for existence against the importation of cheap foreign articles while, in the period preceding the late war, ruthless Japanese competition in woollen piece goods made progress by indigenous mills almost impossible, although the supply of cheap Japanese worsted yarns kept the 73 power and 264 hand hosiery factories in existence and stimulated the Amritsar mills into the production of light weight cloth, shawls and serges. With the outbreak of war in 1939 that supply ceased and the woollen mills struggled along upon a small quantity of yarn imported from Australia and the United Kingdom until the requirements of the defence services put the mills into maximum production of standardized military fabrics. Both then and now, however, the chief product has been medium and coarse quality articles, such as blankets and cloth for uniform, but they have never been able to compete with the foreign supply of finer woollens and worsteds nor with the very cheap rugs and cloths made from shoddy. The inhibition in the production of the former material is related to machinery more than to the supply of raw wool, but it must be admitted that Indian wool is not at present suited for worsteds.

It was the importation of shoddy as much as the competition suffered from the mills and the change of fashion that confined the handloom weavers to the production of *kamblis* and thus reduced their activities to the supply of the coarsest, cheapest articles, but with the outbreak of war there was still left about one lakh of handlooms to turn to the production of blankets and other woollen materials to meet the demand of the forces. With the end of the war, that period of comparative prosperity is over and unless these workers are taught how to improve their methods and their equipment, their industry must dwindle and decay.

This sketchy review of the weaving and spinning industry, it is thought, is sufficient to indicate that if the home market is to be completely supplied by home-grown wool, a considerably greater quantity of crossbred and fine wools must be produced. The needs of these qualities are somewhere in the order of 10 million lb. of the former and 4 million lb. of the latter. It would appear that that amount can easily be produced by 3 million improved sheep representing about 14 per cent of India's sheep population, or 25 per cent of her wool-bearing sheep. That, it is submitted, is a comparatively modest aim which should be fairly quickly achieved, and three articles which are published in this issue and to which we direct the readers' attention, suggest the methods which should be used. It is obvious that the merino, which has been so successfully introduced into other parts of the world, has its limitations in India, but these limitations still allow scope for enormous development. It will be observed too that not all of India's sheep produce only carpet quality wool and that the amount of fine and medium wool is already sufficient to warrant special harvesting and marketing, while the prospect of increasing the amount is bright provided the attempt is made along lines indicated by reason and experience rather than by fancy, and under the direction of those who understand the science of genetics. There are just two technical factors which may limit development along the lines indicated, namely disease and meat requirements. The former calls for persistent research, and the latter the application of commonsense and forbearance in pressing changes to an extreme.

Sir Jogendra Singh
25 May, 1877—2 December, 1946.

PLATE 1

SIR JOGENDRA SINGH

AN OBITUARY

WE record, with heavy heart, the melancholy event which recently robbed India of one of the foremost champions of its most important industry, namely Agriculture; we mean the late Sirdar Sir Jogendra Singh.

Born on the 25th May 1877, nearly 70 years ago, Sir Jogendra devoted himself heart and soul for the best part of his life in championing the cause of agriculture. The education and training young Jogendra Singh had received filled him admirably for a journalist's avocation which he took up in his earlier days with zeal and vigour. Soon he came to prominence through his contributions to several papers in India and England. His success in journalism did not induce him, however, to rest on his oars and he carved out for himself an active life keenly interested in all matters which tended in his estimation to ensure the uplift of his country. His first political success came to him in his early days when he was selected for appointment as Home Minister in the Patiala State. Soon he became prominent in many other spheres of activity. He was elected a fellow of the Punjab University, became President of the Sikh Educational Conference, served as a Member of the Sugar Committee, the Indian Taxation Enquiry Commission, the Skeen Committee and the Army Indianization Committee. In quick succession he was elected to the Council of State, became Prime Minister of Patiala and the Minister in charge of Agriculture in the Punjab, which post he held with distinction for 11 years from 1926 to 1937. He was created a Knight in 1929. In 1942 he was appointed as a Member of the Executive Council of His Excellency the Viceroy in charge of the then Education, Health and Lands Department. He resigned from this position on the eve of the establishment of the Interim Government at the Centre and retired to his Estate at Iqbalnagar, Montgomery district of the Punjab, to enjoy well-earned rest.

In spite of his manifold preoccupations connected with the responsibilities of his high office, Sir Jogendra never for a moment allowed his literary fervour to wane and he managed to find sufficient time to work for a time as Editor of *East and West* and to bring out many publications, such as *Kamla, Nurjahan, Nasrin, Life of B. M. Malabari, Abdulla Ansari, Thus Spoke Guru Nanak, Sikh Ceremonies,* etc.

Sir Jogendra was 'a chip from the old block' of venerable gentlemen. He was indeed a gentleman of the perfect type—polite, unassuming, generous, broad-visioned and free from petty social or political trammels. By his winning manners he endeared himself to all with whom he came in contact either in his private or public life. Truly it can be said of him that he did not touch anything which he did not embellish. His time as Member in charge of the Education, Health and Lands Department will indeed remain specially memorable for the progress achieved in various directions in the fields of agriculture and animal husbandry in India. It was during his time as Member that a separate Department of Agriculture was created. It was his far-sighted wisdom which had prompted him to encourage proposals for the establishment of Central Agricultural and Animal Husbandry Colleges, the constitution of a Central Agricultural Service and the expansion of the Imperial Council of Agricultural Research so that it might become a really national institution and a living force in the sphere of agriculture in the country. His absence has created a gap which it will be difficult to fill. Although he is no longer physically present in our midst his memory remains and it will remain as a never-fainting source from which the present generation will be able to draw inspiration in an endeavour to serve the cause of agriculture in the country.—(S.C.S.)

Original Articles

IMPROVEMENT OF QUANTITY AND QUALITY OF WOOL IN INDIA

By P. N. NANDA

IT has been reported that Indian sheep, on an average, yield only about 2 lb. of coarse or carpet type of wool per head per year. Efforts to improve both the average yield and its quality have been and are being made by:

(i) Cross-breeding local ewes with imported rams having fine wool, such as the Merino.

(ii) Selective breeding of indigenous breeds possessing promising characters.

In a note presented for discussion at the Animal Husbandry Wing Meeting held at Hyderabad in 1945, it was stressed that except for evolving new breeds in specially selected areas and for cross-breeding with particular local breeds, the use of Merino had a very limited scope as Merino rams were expensive to import and did not thrive under conditions met with in most parts of this country. The records available at the Government Livestock Farm, Hissar, indicate that from the year 1911 to 1937, twenty-one Merino rams were imported from Australia in five lots. The average price per ram came to Rs. 265 and on an average, they survived on the Farm for one year and seven months only. This is in spite of the fact that they were kept on the Farm under expert supervision and special care was taken in their management and feeding. Similarly, a number of Merino rams were imported for cross-breeding with indigenous breeds by the United Provinces, Bengal, Bihar, Central Provinces, Orissa, Bombay, Madras, etc. but no tangible results accrued and the plan was consequently abandoned. In this connection particular mention must be made of the systematic efforts made by the United Provinces. For ten years from 1912 to 1922, Merino rams were imported and used but with disappointing results. The rainfall in these provinces is high and under humid conditions the dense Merino fleece has little chance of drying up and consequently diseases such as pneumonia, take a heavy toll. Thus, it would appear that it is futile to attempt cross-breeding with imported rams if climate and other conditions are not suitable. The failure of introducing the Merino in England might be quoted as an appropriate example. The only results of value in this cross-breeding experiment were achieved at the Government Livestock Farm, Hissar, where under climatic conditions somewhat similar to those obtained in certain parts of Australia, a new breed, called the Hissardale, was evolved by crossing Merino rams with Bikaneri ewes. Exact details as to how this was achieved are not available from the Farm records, but it appears that the infusion of Merino blood was repeated and culling, based on conformation and wool quality as judged by feel, was carried out at each succeeding generation. Subsequent observations indicate that the Hissardale had about $\frac{7}{8}$ Merino blood in it. It produces a fine type of Merino wool ranging from 58 to 60s. The average body weight of ewes is 75 to 80 lb. and that of rams from 125 to 135 lb.

A comparison

The returns from the Hissardale flock have been compared in Table I with the Bikaneri flock maintained under identical conditions at the Government Livestock Farm, Hissar.

P. N. NANDA, M.R.C.V.S., is Director of Veterinary Services in the Punjab.

TABLE I

Comparison of returns from Hissardale and Bikaneri flocks

Year	Number of lambs born per 100 ewes		Mortality percentage		Average wool yield in two clips per year in lb.		Average price per maund of wool in Rs.		Remarks
	Bikaneri	Hissardale	Bikaneri	Hissardale	Bikaneri	Hissardale	Bikaneri	Hissardale	
1936–37	80·5	93·2	6·5	9·8	4·50	3·56	27–8 40	40 60	April and Oct. clips
1937–38	72·9	90·8	10·8	11·1	5·50*	3·93	50 38	60 65	
1938–39	76·3	88·2	11·5	17·4	4·49	4·12	28–8 36	37 46	
1939–40	83·8	73·7	10·2	12·9	4·31	3·62	36 37	51 51	
1940–41	89·1	73·1	8·6	21·5	4·90	4·23	46 56	57 56	
1941–42	90·8	93·2	12·5	12·5	4·94	5·05*	56 51	77 66–8	
1942–43	93·3	78·9	22·7	25·4	4·82	6·73†	57 50	96–4 75–12	
1943–44	93·7	76·6	8·7	16·5	5·05	4·79	68 68	96–4 96–4	
1944–45	91·8	78·8	9·6	18·4	4·70	4·57	63 63	91 91	
1945–46	75·5	82·2	12·0	16·7	5·04	5·10	73 62	97 91	
Average	84·7	82·8	11·3	16·2	4·53	4·24	50–5	69–12	

Note—(1) *A few sheep were shorn unwashed during the year.
(2) †Half the sheep were shorn unwashed during this year for experimental purposes.
(3) Wool yields in the years indicated in (1) and (2) have, therefore, not been included to work out the average.

The figures given in Table I indicate that except for the higher price obtained for wool, the Hissardale sheep yield lesser wool, drop fewer lambs and the mortality amongst them is higher as compared with the Bikaneri sheep. Further, before the War, there was little or no market for Hissardale wool as it is difficult to handle and spin without special machinery. Consequently, this wool was offered and sold to well-known mills who paid much better prices than those obtained in the open market. For instance, the best prices offered in the open market (not mills) in the year 1943-44 were as shown in Table II.

The staple length of Hissardale wool is 1 in.-2 in. only. In individual cases, some skilled womenfolk can spin this wool and during the war, when imported wools were not available, the Hissardale wool was locally used for making pullovers, shawls, stockings, gloves, etc., but it cannot be taken up as a cottage industry on a large scale, as the labour involved is so heavy as to make it an uneconomic enterprise in normal times.

TABLE II

Prices of Hissardale and Bikaneri wool in the open market (not mills) in 1943-44

Bikaneri				Hissardale			
First clip	Body	Rs. 52	Per maund	First clip	Body	Rs. 30	Per maund
	Lambs	Rs. 40			Lambs	Rs. 28	
	Belly and legs	Rs. 32			Belly and legs	Rs. 23	
Second clip	Body	Rs. 52	Per maund	Second clip	Body	Rs. 30	Per maund
	Lambs				Lambs	Rs. 28	
	Belly and legs	Rs. 50			Belly and legs	Rs. 23	

Failure of Hissardale

With regard to the use of Hissardale rams for cross-breeding with local ewes in the villages, these rams, when crossed with ewes of a nondescript and poor type, produced progeny with more and better wool, but their value for cross-breeding with the well-known indigenous breeds was of no advantage whatever. For instance, from 1928 to 1942 well over a thousand Hissardale rams and ewes were issued and concentrated in the Kangra district of the Punjab. When the position was reviewed in 1942, it was found that practically no improvement had been effected in the area, as most of the Hissardale sheep issued from the Farm failed to survive for more than a few months. The Hissardale sheep were unable either to keep pace with the local flocks or to adapt themselves to local conditions.

From what has been said above, it may be concluded that, for the improvement of wool, the Merino and the Hissardale sheep have a very limited scope and can only be used with advantage in special areas and under particularly suitable conditions. In most cases, they are unable to survive for any length of time under village conditions and they decrease the fibre length of crossbred animals to such an extent as to render it difficult in spinning, and consequently making it impracticable to be adopted in the cottage industry on any appreciable scale. The handling of Merinos and Hissardales requires special care and management which is not possible under village conditions. Taken as a whole, breeding and maintaining of Hissardales is not a better economic proposition than the Bikaneris.

Improvement by selective breeding

Quality of wool, to whichever class or type it may belong, depends on several factors, such as climate, environment, pasturage, etc. Roughly speaking, India may be classified into three distinct zones. The first zone comprises Madras, Bombay, Bengal, Central Provinces, Bihar, Orissa and part of United Provinces. These provinces produce only a hairy type of wool containing a few true wool fibres. The second zone constitutes a part of the United Provinces, Baroda State, Rajputana, Sindh, Bikaner and Bahawalpur State and a part of the south-east Punjab. These areas produce better wool with a higher percentage of wool fibres. In the third zone may be included the North-West Frontier Province, north-west Punjab, Kashmir State and Baluchistan. Here the wool produced is of a superior quality as compared with the first and second zones.

The diameter of some of the Indian wools as shown in the *Hand Book of Indian Wools* (*Agricultural Marketing in India*) does not really depict the true picture, as notwithstanding the comparatively very small number of samples analysed, the figures are not representative of the type and class of wool produced in different areas and the country. For instance, it would be noticed that 72·1 per cent of the samples analysed came from the first zone, 9·5 per cent from the second zone and 18·4 per cent from the third zone. From the Punjab, which has several well-recognized breeds, only one sample has been analysed. No definite conclusions can, therefore, be based on figures obtained from such analyses. The Punjab has several well-recognized indigenous breeds which breed true to type and the fibre diameter is much less than shown in the *Hand Book* mentioned above.

Two well-known indigenous breeds—the Bikaneri and the Lohi—are maintained at the Government Livestock Farm, Hissar. Before the setting up of a wool laboratory, attention was concentrated on the conformation of the sheep and the quantity of its wool. Quality was only judged by the feel. When the wool laboratory made the physical analysis of wool possible, it was discovered that hairiness or medullation varied in individuals from 5 to 90 per cent in both the flocks. The two flocks were then classed into A, B, C and D types according to the quality of the fleeces as follows:

A type	0 to 20 per cent medullation
B type	20 to 40 per cent ,,
C type	40 to 70 per cent ,,
D type	70 per cent and higher medullation

The diameter of wool fibres was studied in six sheep each, from A, B and C types of Bikaneri breed and the following figures were recorded:

	A	B	C
Average	32·19 micron	34·90 micron	37·50 micron
Minimum	28·6 micron	..	..
Maximum	..	..	41·6 micron

Similarly the mean diameters in samples of Lohi wool examined were :

	A	B	C
Mean diameter	24·25 micron	32·2 micron	40·6 micron

The minimum diameter in Bikaneri sheep in Class A shows that the quality is not less than 56s and in the Lohi 60s.

Potentialities of the two breeds

Noticing the potentialities exhibited by the two breeds, it was decided to try and increase the number of sheep in A and B classes, by using rams of A and B types only and gradually eliminating the C and D types. The wool quality of the progeny was tested at the first clip in the case of female lambs and at the second clip in the case of male lambs. Table III indicates the progress made in three years.

TABLE III

Improvement in wool quality of progeny

Year	Sex of progeny	Percentage in the various classes			
		A	B	C	D
		Lohi			
1943	Males	11·8	11·8	40·8	35·6
1944	,,	18·2	15·9	31·8	34·1
1945	,,	24·4	15·1	40·7	19·8
1943	Females	7·8	13·7	39·2	39·2
1944	,,	12·0	10·3	44·8	32·8
1945	,,	20·2	18·9	35·2	25·7
		Bikaneri			
1943	Males	4·7	10·8	35·5	49·0
1944	,,	6·1	19·4	46·6	27·9
1945	,,	8·2	22·8	49·7	19·3
1943	Females	7·3	22·0	37·5	33·2
1944	,,	13·1	18·6	40·7	27·6
1945	,,	14·8	17·6	40·5	27·1

The results achieved and shown in Table III within a short period of three years are very encouraging, particularly when it is considered that the basic flocks on which improvement work was undertaken were of a type in which the hairy animals predominated. The most striking observation, however, is that animals in A and B types breed true to type, i.e. when A and B class ewes are put to A and B class rams, the progeny, in the large majority of cases, is also of A and B type.

As regards quantity of wool produced, the yield from Bikaneri sheep, if bred scientifically, compares favourably with that of other foreign well-known breeds such as the Merino if the comparison is made on scoured basis.

Class of sheep	Average wool yield per year in lb.	Scouring loss, maximum	Net yield in lb.
Merino (Australia)	7·0	50 per cent	3·0
Bikaneri (Hissardale)	4·5	20 per cent	3·6

It should be noted that the above average (4·5 lb.) for a flock of 500 Bikaneri sheep at the Hissar Farm has been calculated on the figures obtained when all sheep were washed before shearing. If the average were to be worked out on unwashed sheep, as is the general practice in villages, it would come to over 6 lb. per head per year as against 2 lb. for the whole country. This indicates a threefold increase in fleece weight which can be achieved by systematic breeding of indigenous sheep. Individual maximum yields on washed wool basis—12·5 lb. in a ram, 9·8 lb. in a ewe—also indicate the potentialities of the breed.

It is apparent from the above that improvement of wool by selective breeding of indigenous sheep is a practical proposition, that some of the indigenous breeds possess marked potentialities both for quality and quantity of wool and that the genetic behaviour of desirable characters in wool during the process of interbreeding of such animals shows that such characters are transmitted to the progeny. From observations made at Hissar, it is clear that the desired results can be achieved by selective breeding and are well within the scope of an ordinary breeder in the village.

THE COMMERCIAL DAIRY COW

By T. W. MILLEN

MANY dairies are being started all over India to increase the inadequate supply of milk. Most of these are sponsored by men who hope to secure financial benefit from their venture. Also people who have never kept cattle before are now maintaining enough cows and buffaloes to supply the milk needed in their own households. In this article an attempt is made to point out some of the factors which will determine whether the venture is economically sound or not.

Buffaloes versus cows

We cannot recommend the keeping of buffaloes from our experience at the Agricultural Institute. Although we have good registered Murrah buffaloes from a fine stock, and lactations of 5,000 pounds or more of milk are not uncommon, still the buffalo is a large animal and takes a rest for several months on alternate years. Our buffalo herd just pays for its feed. We admit that 95 per cent of the milk sold in some of the cities of India is buffalo milk and few productive cows are found in the villages yet we would not attempt to run commercial dairy with many buffaloes in the herd.

What cows to keep

There are several breeds of Zebu cattle that have produced individuals yielding adequate quantities of milk. The Imperial Council of Agricultural Research maintains herd registers for the Sahiwal, Red Sindhi, Hariana, Gir, and Kankrej breeds. Herd books are proposed for the Ongole and Tharparkar also. We have chosen the Red Sindhi but recognize the possibilities of the other breeds. We feel that the foundation stock for a commercial dairy should be of the best individuals available in one of these breeds.

We cannot advise anyone to keep *desi* cows, no matter how cheaply they are purchased for sooner or later they will become a burden. The prevalent method of buying fresh cows, milking them till they no longer pay for their feed and then disposing them of is not a good practice. The stock in the country becomes depleted, and when restrictions are enforced in the producing areas, great hardship is experienced. The best way to maintain a good herd is to start with the best animals obtainable and to improve it by selective breeding; raising most if not all of the needed replacements.

The herd sire

Unless the breeding bull is better than the average of the cows, the herd will deteriorate rather than improve. If possible his female ancestors should yield at least 1½ times the herd average. A bull that has sired productive daughters should be kept when obtainable.

Cross-breeding

The present Zebu breeds are not uniform in conformity or performance. The best yielding cows may have useless daughters. It will take decades to develop a herd in which all the females produced will be economical yielders. For quick results foreign dairy bulls may be used on Zebu stock. The crossbred females will usually be the money makers. There is at present in India an almost universal prejudice against cross-breeding. Careful enquiry reveals that this prejudice is not based on practical experience but hearsay.

The military dairies have used Holstein-Friesian crosses in their dairies and have often graded up Zebu stock to 31/32 or more Holstein-Friesian. These military dairies also maintain a high proportion of buffaloes in their herds so that the mixed milk is acceptable to the army personnel after 'toning' it to the legal butter fat content. For large milk yields the Holstein-Friesian crossed on the Sahiwal would be a good combination. We, however, are interested in keeping a smaller cow giving richer milk. The Jersey-Sindhi gives us an animal, about three-fourths the size of the

T. W. MILLEN, M. Sc., D.V.M., is the Head of the Department of Animal Husbandry and Dairying at the Agricultural Institute, Allahabad.

Holstein-Friesian × Sahiwal, which yields rich milk in profitable amounts.

Another advantage of the Jersey × Sindhi cross is that a herd of uniform colour can be maintained if the Jersey sire is dark fawn and the Red Sindhi cows are homozygous red. Both breeds have black muzzles, switches and eyelids and the dark fawn blends well with the Sindhi red.

The long-time policy

Many worry about the next generation and ask about the F_2. We do not recommend the interbreeding of crossbreds. We would use only purebred sires except for the first cross when a crossbred bull could be used on pure Zebu cows. We have been able to fix increased milk production in cows graded back to the Red Sindhi until only $\frac{1}{16}$th of the Jersey blood remained. We do cull out some of the $\frac{1}{4}$, and $\frac{1}{8}$ Jerseys but fewer of these were unprofitable than were their Sindhi mothers. We used the Jersey bull on only Sindhi cows giving less than 2,000 pounds per lactation, and produced daughters yielding $2\frac{1}{2}$ to 3 times this amount.

What is a profitable yield

A number of factors enter into the calculation of profits and losses in the dairy business. Twenty years ago a committee at the Institute agreed that a cow should produce 2,050 pounds of milk to pay for her feed. Figures are not available to show how this was determined but under present conditions a cow giving 2,000 pounds of milk per year would just pay her expenses.

The following figures are based on the actual feed costs and production records of the cows in our herd during the year 1945. We credited the cows with 2 as. for each pound of milk produced. This is considered a wholesale rate allowing a margin for retail costs. The cows were fed roughage at the rate of 10 lb. green basis per 100 pounds of body weight and the average cow weighed about 750 lb. They were given concentrate mixture according to their age, condition and production. This amounted to $1\frac{1}{2}$ to $2\frac{1}{2}$ lb. per cow for maintenance and 1 lb. for every three pounds of milk produced. The fodder changed in type as did also the concentrate mixture as the season changed or certain feed stuffs became unavailable. Dry fodder was fed at the rate of one pound for three pounds of green feed and silage at the rate of two pounds for three pounds of green feed.

Chaffed green feed was given daily along with *jowar* and *bajra* silage, chopped stover or wheat straw. This green roughage consisted primarily of napier grass, cowpeas, lucerne, guinea grass, sunflower, fodder raddish and mixed field grasses. Green fodder cost approximately 12 as. per maund, the silage 9 as. per maund and the concentrate mixture Rs. 4-8-4 per maund[1]. All the cows were stall-fed or, if dry, fed in mangers in the paddock. The concentrate mixture contained minerals and plenty of fresh water was provided.

Our labour, water, veterinary and miscellaneous charges for our herd of 170 dairy animals averaged about Rs. 44 per cow in addition to the feed charges. We kept a herd book in which the monthly feed cost and production records were recorded. We found that a cow yielding 1,465 lb. of milk just paid for her feed. One giving 2,000 lb. would pay for her feed and other expenses but give us no profit. Table I shows the average values for cows in our herd last year.

TABLE I

Value of milk over feed cost and annual lactation

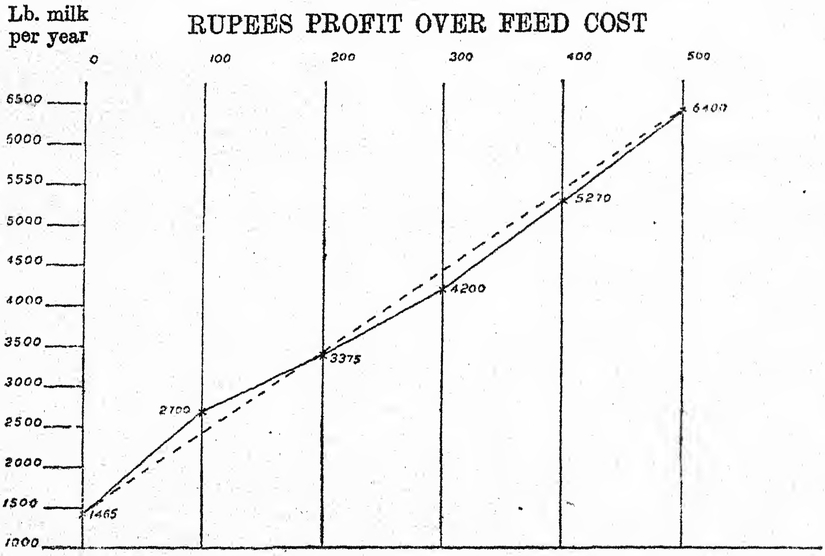
Value of milk over feed cost in Rupees	Annual lactation in pounds
Nil	1,465
100	2,700
200	3,375
300	4,200
400	5,270
500	6,400

These figures almost make a straight line when plotted on a graph. From this graph profits for other yields can be easily determined.

During our financial year (April 1, 1945 to March 31, 1946), 18 Red Sindhi cows completed their lactations averaging 3,005 lb. of milk in 308 days with 214·8 days dry preceding this lactation for 14 of them, four being first lactation heifers. This 5·75 lb. overall daily average would give an annual yield of 2,096 lb. and an average of about ten rupees per cow over her

[1] Present concentrate rates are about 50 per cent higher.

feed and other costs. The 14 Jersey-Sindhi cows completing their lactations yielded an average of 5,160·6 lb. in 377·8 days with 60·4 days dry for 13 cows. One was a first lactation heifer.



In this case the overall average is 11·78 lb. daily with an annual yield of 4,299·7 lb. Here both the higher lactation yield and the shorter dry period count. These cows gave about Rs. 270 each over feed, labour and miscellaneous costs. It would take 27 of the Red Sindhis to give the same profit over feed cost as one cross-bred.

The comparative investment

In these calculations we have not taken into account interest on the investment or replacement charges. The cows will average possibly six lactations if well cared for, so one-sixth of her purchase price must be deducted from the profit earned by each cow per year for the first six years. On the other hand, we must credit the cow with about Rs. 60 for the manure produced during the year if it is used efficiently as fertilizer or sold as fuel cakes in a good market.

What does a cow cost?

Cattle prices are determined by supply and demand. Individual quality is an important factor. We sold two cows during the past year for Rs. 900 each and a number at Rs. 850 each. Cows purchased by us cost a little over Rs. 750 each when we allowed credit for the accompanying calves. Home-raised heifers were a little cheaper, 67 first lactation heifers taken into the herd last year costing about Rs. 640 each.

Calves now being raised will be more expensive owing to increased labour and feed prices. In all our calculations we have considered the cow's feed only and her full production. The calf is weaned at birth and raised separately as a capital item or discarded.

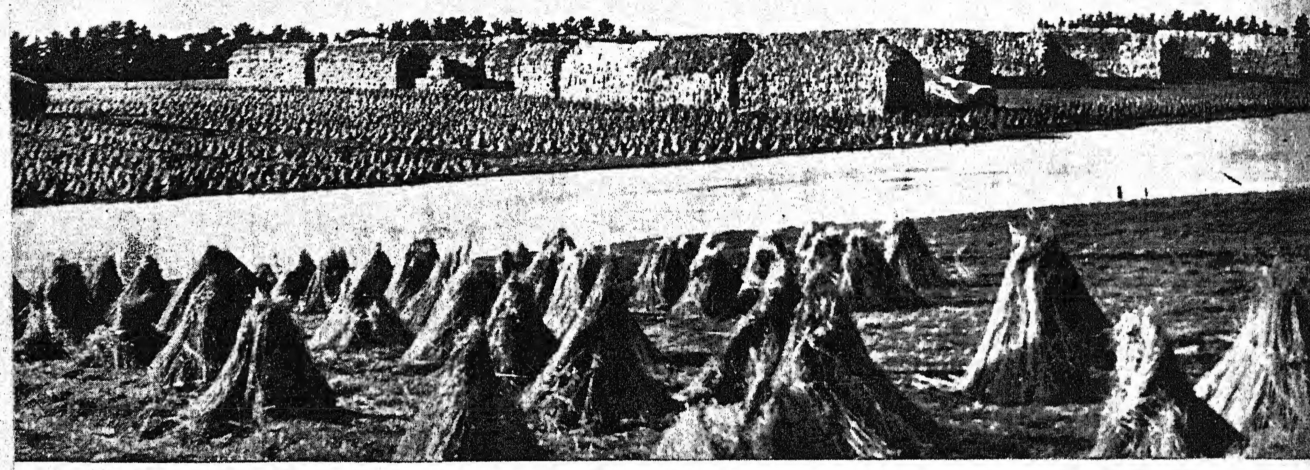
The commercial dairy cow

A cow to be commercially profitable in our dairy should yield a minimum of 3,250 lb. of milk per year.

Cost of cow Rs. 750

ASSETS—	1. Profit of milk (8 lb. per rupee) over feed cost	Rs.	184
	2. Manure value	Rs.	60
	Total ..	Rs.	244
DEBIT—	1. Annual replacement depreciation ..	Rs.	125
	2. 10 per cent profit on investment ..	Rs.	75
	3. Labour and miscellaneous charges ..	Rs.	44
	Total ..	Rs.	244

Our best cow last year gave an annual yield of 6,870·8 lb. leaving Rs. 433 for our profit on our investment. The best registered Red Sindhi (Birquee Registration No. 0407 in her first lactation) gave an annual yield of 5,448·3 lb., with Rs. 335 profit on the investment. In our herd 65 cows gave from 10 to 58 per cent on our investment last year. Commercial dairies are possible in India. We have one.



Gaited flax straw after tank retting at a flax mill at Strathkellar, Victoria

PLATE 2

FLAX PRODUCTION IN AUSTRALIA

By J. A. STEVENSON

ALTHOUGH her pre-war flax output was negligible, Australia expanded production to such an extent during the war that she was able to send a total of 7,000 tons of flax fibre to Britain, and is now in a position to meet her own domestic requirements of this important industrial crop.

Developed as part of the Empire-wide flax production programme, the Australian flax industry by 1942 had 39 new mills in operation, handling the product of more than 60,000 acres of flax grown in the States of Victoria, South Australia, Western Australia and Tasmania.

Today this government-sponsored industry operates 24 mills and grows 30,000 acres of flax, or just enough to meet Australia's own needs.

As flax-growing was developed under war conditions with wartime prices, authorities have yet to determine whether it will remain a permanent feature of Australia's agricultural economy.

In the past there have been many attempts at flax growing in Australia. Companies have come and gone and shareholders have lost their money over a period of more than 60 years.

In 1935, after many vicissitudes, a new attempt was made to establish the industry. New seed was brought in from England by a private company and, between 1935 and 1939, the area of flax in Australia was increased from 200 acres to 2,000 acres. The aim was to ensure supplies of fibre in the event of war breaking out.

The sponsors had no thought of anything other than production for Australian requirements, and when the war did break out they offered their services to the Commonwealth to help increase production as far as possible with the seed available and provide fibre for essential purposes.

Early in 1940, the Commonwealth Government decided that the area of flax in Australia should be extended to 8,000 acres, and that the fibre produced should be directed to essential manufacture in Australia.

J. A. STEVENSON is the Chairman of the Commonwealth of Australia Flax Production Committee.

Rapid expansion

In June 1940, however, the British Government asked the Commonwealth Government to assist in an Empire-wide flax production programme, and to purchase sufficient seed to sow an additional 12,000 acres. The Commonwealth readily agreed and thus, by the end of June, 1940, Australia was committed to a 20,000 acre flax production programme.

The planning and organization associated with the sowing of those 20,000 acres was carried out very rapidly because it was essential to sow the crop as soon as possible. Flax is an autumn-sown crop in Australia and, therefore, the project was already late. In the first year it had to be directed into districts where spring sowing had some chance of success. The Government guaranteed farmers a return of Rs. 45 per acre in this first year because of the risks associated with the late sowing.

In order to carry out the flax production programme, the Commonwealth Government acquired the interests of the private company which had previoulsy operated, and set up a Flax Production Committee to direct the whole of the flax production enterprise in Australia. Flax was sown in the States of Victoria, Tasmania and Western Australia in the first year, and arrangements were made for the erection and equipment of a number of flax mills.

The whole of the plant required for these mills was manufactured in Australia, and by January 1941, they were ready to process the straw which had been growing during the previous few months.

Unfortunately, seasonal conditions were not good but, nevertheless, there was a certain quantity of straw to process and fibre production commenced early in 1941.

In the meantime, the British Government, having lost access to the principal sources of supply of flax in the Batlic States and North Western Europe, had asked the Commonwealth Government to increase the acreage of flax for the purpose of supplying British requirements. Australia was asked to supply to Britain the flax from 50,000 acres and, as Australian requirements had now increased,

a programme of up to 70,000 acres was set for 1941.

This involved feverish activity in the erection and equipment of additional mills. By 1942, the Flax Production Committee was operating 39 mills throughout Australia, and had over 60,000 acres of flax under its direction.

Expansion meant breaking in another State to the production field. South Australia was allotted an area, and four mills were set up in that State.

The building up of this industry involved a tremendous amount of organization, and also necessitated the selection and training of mill managers, supervisors, and employees for the mills. At one stage, over 3,000 employees were engaged in the harvesting, delivery and processing of flax straw. All of these employees had to be taught, because when the war broke out there were only very few trained flax employees engaged in the industry.

The three years following 1941 were devoted to consolidation of the position and to a general improvement in handling and processing technique as a result of research work which had been proceeding parallel with the development of the industry.

One hundred tons per week

By the end of 1943 the industry in Australia was producing flax fibre at the rate of 100 tons per week as compared with less than 100 tons per annum in the year 1939. During the war Australia produced a total of 11,000 tons of flax fibre. Of this 7,000 tons was exported to the United Kingdom, where the fibre was used in the manufacture of many essential articles of war equipment.

Although many mistakes were made in the course of establishing the industry, most of the selection of districts and farmers proved to be satisfactory. Where districts were proved to be unsuitable they were not encouraged to proceed with the production of the crop.

By 1945, the number of mills in regular operation had been reduced to 24, although they were serving the same acreage as was booked in the year 1941. This reduction in the number of mills was due to experience during these few years proving that certain districts were highly suitable to the production of flax, whilst others had no chance of success.

By the end of 1945 the flax production industry in Australia was in a position to look to the future for permanent establishment at least as a supplier of the whole of Australian needs. To provide those needs will require the produce of 30,000 acres of flax, and the Commonwealth and State Governments have agreed to a programme of 30,000 acres of flax in the years 1946 and 1947.

During those years information will be gathered relating to the technical and other problems associated with flax processing. Research work will be intensified and by the end of the period, it should be possible to determine whether any further extension of the period of production should be undertaken.

During the war the price per ton of standard straw delivered at the Australian mills rose from Rs. 50 in 1940 to Rs. 80 in 1943, and remained at that level until 1945. This relatively high price was maintained to keep farmers in poor marginal areas in production, as Britain needed fibre regardless of the cost. With bonuses for length of straw, freedom from weeds, good quality and proper delivery many farmers received up to Rs. 100 per ton during this period.

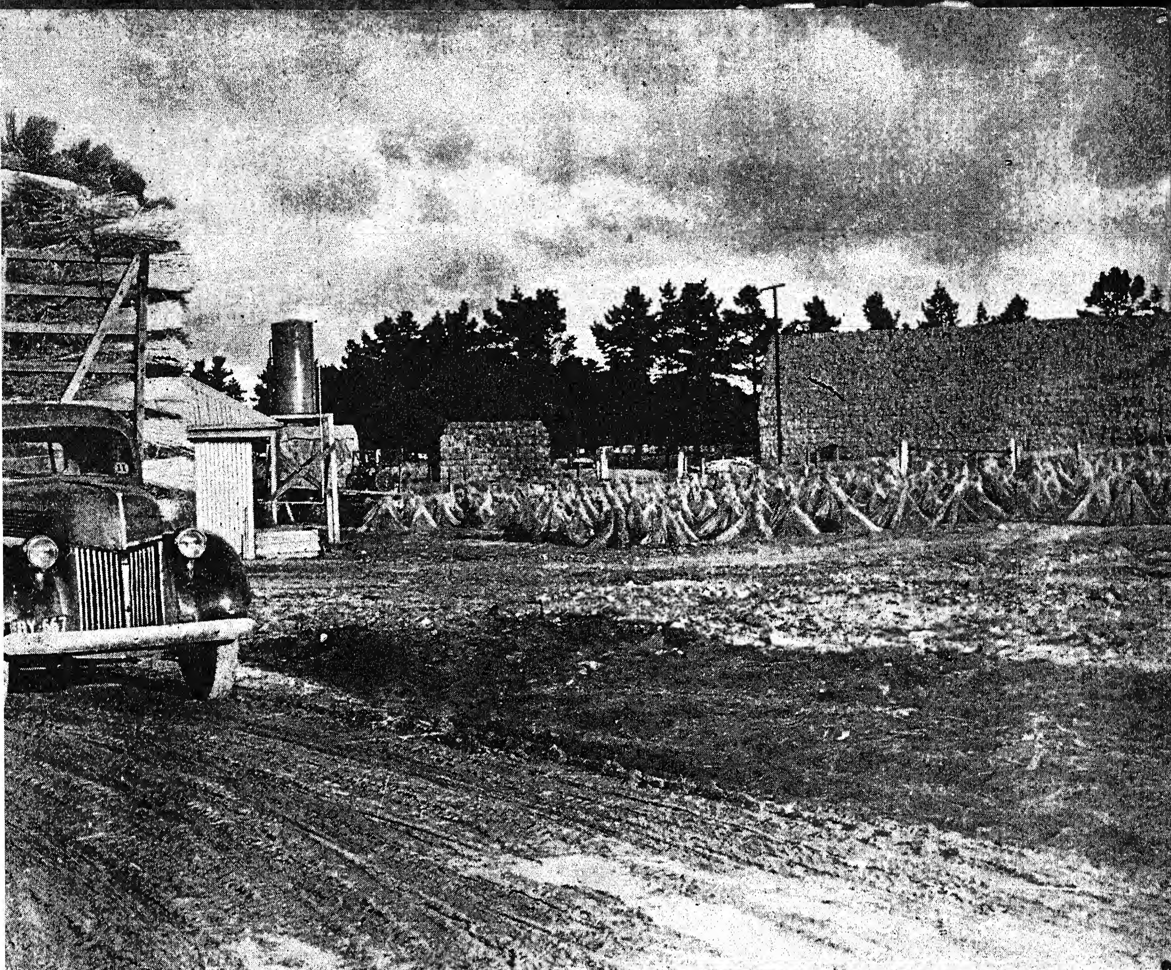
Now that flax growing is being confined to suitable areas only in Australia, the price per ton of standard straw has been reduced to Rs. 72-8. Further reductions in the price will occur as production costs are lowered.

Owing to adverse seasons during the war years, and the necessity of growing in unsatisfactory localities, average flax yields in Australia have remained under one ton per acre; up to three tons per acre have been obtained in suitable areas.

Organization of industry

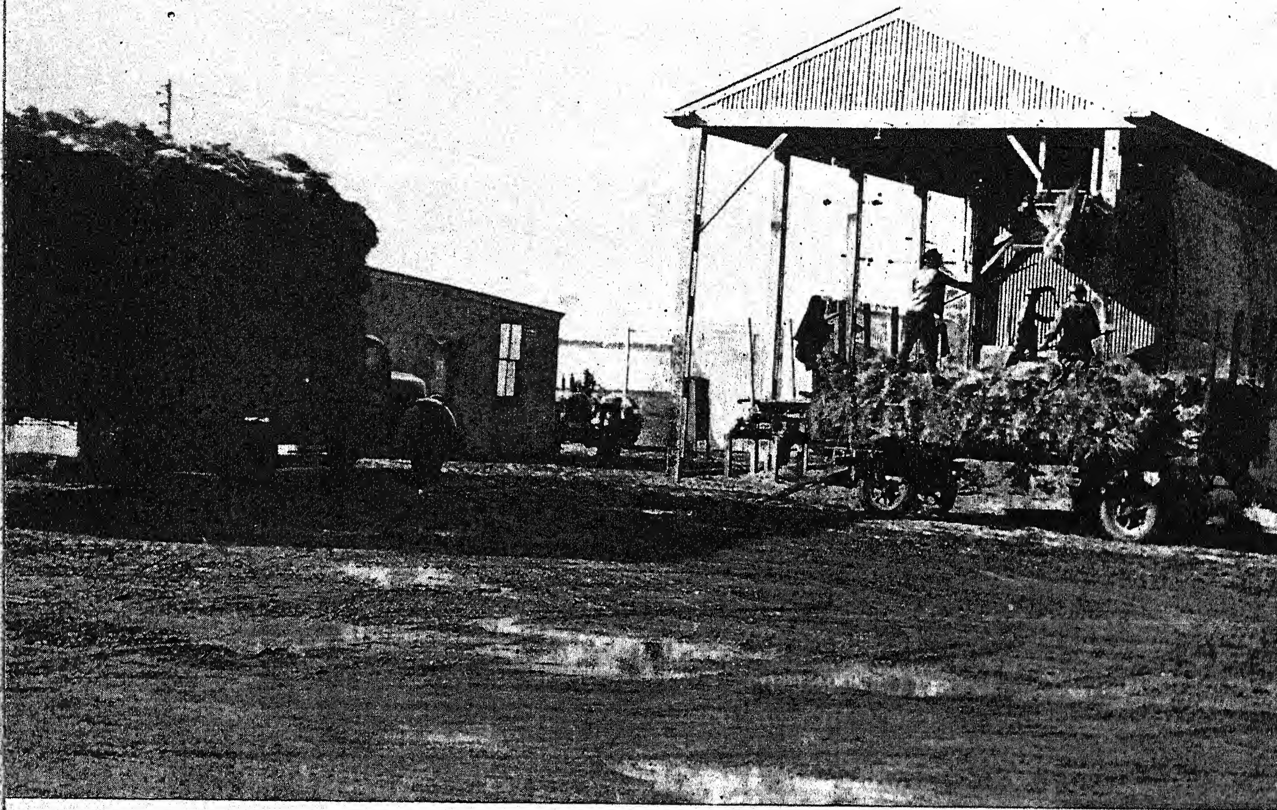
The establishment of flax production in Australia has introduced several new features into the organization of Australian primary producers. The Flax Production Committee has sponsored the establishment of a Flax Growers' Association, which has a branch in each district where flax is grown.

The district branches send delegates to a State Association, and every six months the State Associations send two representatives to a Federal Executive meeting in Melbourne. This Federal Executive considers various proposals put forward from the branches and, after reviewing those proposals, places its views thereon before the Flax Production Committee. One of the principal items of discussions is the



Trucking harvested straw to flax mill at Ballarat, Victoria

PLATE 3



Deseeded flax straw being loaded on a trailer at flax mill at Lake Bolac, Victoria

PLATE 6

contract which sets out each year the terms and conditions under which flax is grown.

This half-yearly conference has proved an excellent means of maintaining close co-operation between the growers and the Flax Production Committee. The Committee purchases the flax straw from the growers on a definite contract, the details of which are known to the farmers before the seed is sown. The Committee supervises the preparation and distribution of the seed, which is subjected to strict germination and purity tests before being distributed.

If, through no fault of his own, the farmer does not obtain a crop from the seed issued to him by the Committee, he is not charged for that seed. The flax contract is regarded by flax growers as an outstanding example of what can be achieved by collaboration between primary producers and the buyer of their products.

Besides keeping in touch with the growers in regard to conditions under which flax is grown, the Flax Production Committee furnishes them with advice from time to time as to the best methods of preparing their land and growing and harvesting their crops, and provides a satisfactory extension service on all agricultural matters.

The seed which was introduced into Australia under the present scheme was sent from the United Kingdom and, although it has produced reasonable crops, it is not entirely suited to Australian conditions. A flax breeding programme was inaugurated in 1942 with the object of breeding a suitable variety for Australian conditions.

Fighting disease

In the course of this investigation, action is also being taken to breed a flax which is resistant to rust and to other diseases which affect the flax plant. An early maturing variety is also desired so as to avoid the attacks of caterpillars, which cause considerable damage to the seed. Remarkable progress has already been made in this breeding campaign which is, of course, a long-range project. Already some success appears to have been attained in the development of a rust-resistant early maturing variety.

Research has not been limited to the agricultural side of the industry, although a considerable amount of work has been done in connection with the time of sowing, the rate of sowing, preparation of the land, harvesting of the crop, rate of application of fertilizers, and many other factors associated with the growing of flax.

Some of the diseases have been completely eradicated, and active work is being undertaken in relation to others. The retting and mechanical processing of the flax have also been the subject of a great deal of research. The retting technique today is far in advance of what it was in 1940, and the introduction of mechanization in the mills has assisted materially in reducing costs of production. Now that the war is over and research officers are likely to be available, it is hoped that further improvements will be achieved during the next two years.

Spinning and weaving

During the war, the manufacture of flax into yarn, threads, cordage, canvas, fire hose and other linen goods has been developed to a remarkable extent in Australia. Factories are now equipped in this country to spin and weave practically the whole of Australia's requirements. These factories are now turning their attention from war goods to peace goods, and they will absorb the product of the 30,000 acres of flax which are now to be sown. Thus, the flax industry today is in a better position to progress than it has ever been in the history of Australia. Prior to the war, there was very little manufacture of Australian-grown flax, and the only outlet for increased production of the fibre was on the export market, where severe competition was experienced from foreign producers.

Whether or not Australia will continue to grow flax has yet to be decided. Much will depend on the results of the work over the next two years, but it is certain that many Australian farmers who have experienced the advantage of flax production during this period will desire to continue to grow it.

A METHOD OF IMPROVING INDIA'S WOOL PRODUCTION

By RAM CHANDRA HAKSAR

BEFORE a policy for the improvement of wool-growing industry in India can be laid down it is obviously necessary to examine the industry as it exists at present and the potentialities it offers for improvement.

During the last 150 years or so, of which some records exist, stray and unsustained efforts have been made here and there to improve local sheep by cross-breeding and although results in some cases, particularly with Merino cross-breeding, were promising, no efforts were made to carry out the experiments to their logical end and produce a superior animal except in the case of Hissardale[1]. There are no records to show whether any scientific and selective inter-breeding has ever been attempted on Indian sheep. Since this is a long drawn out process of effecting improvement it is likely that breeders, who probably wanted quick results, were not inclined to follow this line of breeding.

The present state of sheep husbandry in India is thus a result of centuries of neglect. Nevertheless in certain areas where the flora and climatic conditions were exceptionally favourable and the geographical situation conferred a comparative degree of insulation against infiltration of outside strain, certain types have been developed with conspicuous physical and wool characteristics. Although even such isolated sheep do not breed true to type and in the flock of the same type various specimens are to be found, yet there is a vague family likeness which has potentialities of development if a suitable breeding policy is followed.

As the scope of this article is confined to wool production and its improvement, qualitative and quantitative, no reference to mutton will be made for which our Indian sheep are primarily reared, wool being regarded only as a by-product.

[1] *Notes on Wool in India* by Silver and Mehta, published by the Government of India, pp. 21-26.

RAM CHANDRA HAKSAR, M.Sc., is Officer-in-charge, Kashmir Sheep Breeding Scheme, Kashmir.

Indian sheep as producers of wool

Let us then examine where our Indian sheep stand as producers of wool.

The only authoritative and scientific information on the subject can be had from (a) *Hand Book on the Quality of Indian Wool*, 1942, (*Agricultural Marketing in India*), (b) *Third Report of the Bombay University I.C.A.R. Scheme for the Analysis of Wool* (1943-44) and (c) *Some Common Breeds of Indian Sheep* published by I.C.A.R. (1942).

In the first two publications the results of analyses of 317 samples of wool from different parts of India are given. It is obvious that this number is too small to adequately represent 85 million sheep of India. The writer has prepared the following Table (Table I) about the wool diameters from pages 21-31 of the *Hand Book of Indian Wools*.

TABLE I

Wool diameters of Indian sheep

Area to which wool belonged	No. of samples taken	Maximum diameter in microns	Minimum diameter in microns
1. Bikaner ..	8	53	37
2. Baroda ..	4	84	36
3. Rajputana ..	2	44	42
4. Kathiawar ..	12	51	37
5. Cutch ..	1	42	..
6. Madras ..	24	104	43
7. North-West Frontier Province	11	52	20
8. United Provinces	23	75	37
9. Bombay ..	14	68	35
10. Bihar ..	3	55	46
11. Punjab ..	1	50	..
12. Gujrat ..	2	49	41
13. Kashmir ..	15	53	31
14. Mysore ..	25*	82	39
15. Central Provinces	2	52	50

*Merino crossbred sheep have not been taken.

From a perusal of Table I it will be found that:

1. The best specimens from the coarsest types of wools with one or two exceptions, show a diameter of over 49 microns which expressed in standard counts means that the wools are far below 32s which is the lowest rung of the ladder of wool standards (carpet wool).

2. The best specimens from the best types of Indian wools—with the exception of a sample from the North-West Frontier Province whose minimum diameter is given as 20 microns and which either is incorrect or has been taken from a Merino cross, and a sample of wool from Kashmir whose diameter is 31 microns—show a diameter of over 35 microns which in standard counts means that the wools are between 46 and 48 counts (ordinary clothing wools).

3. These samples contain from a maximum of 61 per cent of kemp to nil.

A persual of the analysis of 23 selected fleeces from different parts of India given on pages 36, 37 and 38 of *Hand Book of Indian Wool* shows that (a) Fleeces whose diameters are above 45 microns are =13 (below 36s).

(b) Fleeces whose diameters are between 42 microns and 45 microns are=3 (between 36 and 40s).

(c) Fleeces whose diameters are between 36 and 42 microns are=5 (between 40 and 46s).

(d) Fleeces whose diameters are between 34 and 36 microns are =2 (between 46 and 48s).

The kemp percentage varies from 0 to 34 and medullation from 87·5 to 5 per cent.

From a perusal of the Table No. I given on page 3 of the *Third Annual Report of the I.C.A.R. Scheme in operation at the Bombay University* for the analysis of Indian wools the following points are brought to notice:

That out of the samples of 146 sheep examined:

(a) 18 are classed as fine wool free from medullation. It should be noted that out of the 18 samples five are from pure Merinos from Banihal Farm, nine are crossbred Merinos from Poona, Hissar and Banihal, two are Hissardales and only two are from local sheep of Kashmir maintained at the Banihal Farm. Thus the percentage of fine wool type of local sheep is 1·6.

(b) 21 sheep are classed as medium quality wool, even grade with little medullation. Out of these 21 samples—one is from Russian sheep, Kazak, which the writer sent and two are from crossbred Merinos. Thus there are only 18 samples of Indian sheep out of 146 samples, that is 12 per cent, which give a medium quality wool which has little medullation.

(c) 107 samples are classed as coarse quality, uneven grade and highly medullated. The percentage of such samples is 73.

The following conclusions can be drawn from the data presented above (it is already conceded that the data are not adequate).

1. That 70 to 80 per cent of Indian wools are of a very inferior quality, are kempy and highly medullated. They are far below the lowest rung of the ladder of wool standards—below 32 counts.

2. That about 10 to 15 per cent range between 36 and 46s with medullation.

3. That only 4 to 5 per cent range between 46 and 48s with little or no medullation.

4. That the comparatively better wool producing sheep are confined to a few areas and there too good specimens are found in very small numbers.

But as all these wools are mixed up when available to the manufacturer they are classed as carpet wools below 32-36s and fetch the lowest price in the market.

As regards the weight of fleece, Indian wools are the lightest in the world. A reference to page 16 of the *Hand Book of Indian Wools* will show that the average annual yield of wool per sheep in India is 1·9 lb. which is the lowest average.

Reference to the article on 'Some Common Breeds of Indian Sheep' published in *Indian Farming*, page 125, will show that the best-known types of Indian sheep give an average of 3 to 4 lb. per year per sheep. The average of 4-6 lb. of Dumari (Harnai) sheep appears to be doubtful. Some sheep in government farms, where good grazing is available, may yield this average but this is not the case in the common villages. However, the yield of wool is very low and thus whether from the point of view of quality or quantity there is much to be desired in the Indian sheep.

I shall now discuss some of the points raised with regard to the introduction of Merino strain in Indian sheep.

It has been stated that Merino cross-breeding at Hissar has produced very promising results and the Hissardale breed, that has been evolved as a result of it, is a very desirable breed and

yet it has been recommended 'that the use of purebred Merino for cross-breeding, has a very limited scope of application in this country' 'Merino', it is said, 'is expensive to import, it is generally unable to stand up to local climatic conditions, its wool is greasy, the staple is short and cannot be spun without machinery.[1]

The infusion of Merino strain

If by the infusion of Merino strain in Bikaneri sheep, which was the foundation stock of Hissardale, such a useful breed as Hissardale could be evolved, why can not the Merino strain be introduced in other sheep in India and useful breeds of sheep evolved with different gradations of wool? A very marked feature of the introduction of the Merino strain is that it practically eliminates kemp and medullation which are very serious defects in Indian wools in the very first cross. Besides it increases wool density which is very badly wanting in Indian breeds.

With regard to the criticism that Merino strain shortens the staple it may be suggested that Merinos of comparatively longer staples can be used and only as much Merino blood should be introduced as would not adversely affect the staple length. From a vague correlation that exists between diameter and staple length of wool fibre it can be safely stated that the majority of Indian wools which are very coarse cannot possibly have very short staples. Such staples cannot be adversely affected by the introduction of a Merino strain.

The Merino is no doubt expensive as compared to local sheep but in the development of the wool industry in India economy should not be the first item. A large purebred Merino flock can be maintained in any suitable place in India which will supply Merino stock to the different sub-stations set up. Japan on the conquest of Manchuria imported 5,000 Merinos from Australia and developed the wool-growing industry in that province in a very short time.

It has been said that '*Merino is unable to stand up to local climatic conditions*'. Hissar is one of the hottest places in India and if Merino could be successfully handled there to produce the Hissardales it can be handled elsewhere too. Merino can withstand a very varied climate. It only requires a skilful handling. It has been successfully reared in the snows of Siberia and it is reared in Western Australia which is as hot a region as are most parts of India. Each area imprints its own stamp on the wool produced. It is indeed true that Merino produces the best wool in a temperate climate with a rainfall not exceeding 25 inches. But Merino rearing does not necessarily imply rearing the superfine Merino of super 90s. Heavy rainfall is not conducive to successful Merino rearing; but even this handicap is circumvented by the New Zealand breeders who shift their stocks during the heavy rainy seasons to the tops of distant high mountains, like the sheep breeders of Kangra in the Punjab, or take them across the mountains where the rainfall is less.

Then again we are told that '*Merino wool is greasy and cannot be spun without the aid of machinery*'. It has been demonstrated here that with a little skill and training pure Merino wool can be easily handled even by villagers. Pure Merino wool was washed, cleaned, combed and spun by a village woman at a recent demonstration. There is a huge demand for the pure Merino wool at the farm and orders are booked long before shearing. It is selling at Rs. 240 a maund (Rs. 3 a lb.).

But since it is proposed to develop crossbred types the question of handling large quantities of pure Merino greasy wool does not arise. Crossbred wools not being very greasy are not difficult to handle. We have sold hundreds of maunds to villagers and they spin quite well.

In face of these facts, and when improvement of wools is the main item of the programme in the handling of Indian sheep, to give a second place to Merino—which is by far the best wool breed and which adapts itself to a very wide range of climatic conditions is to give a wrong lead to the whole effort.

Carpet Wool

Stress has been laid on the development of carpet wool breeds of sheep[1].

Wools which are below 32 counts are classed as carpet wools. They are of the poorest quality, coarse and medullated and fetch the lowest prices. No advanced country in the world where the standard of living is high produces carpet wools. A reference to page 3 of the *Hand Book of Indian Wools* will show that out of approximately 3,535 million lb.

[1] Note by P. N. Nanda presented to the 6th Animal Husbandry Wing Meeting, Hyderabad, 1945

of wool produced in the world only 11·6 per cent are classed as carpet wool and are produced wholly in backward countries like China, India, Iran, etc. In fact carpet wools bring such a small return to wool growers that they can be grown only in such countries where standard of living, like that of our Indian sheep breeders, is miserably low. Whereas the Merino and crossbred wools fetched 18 to 20 and 15 to 18 pence per lb. respectively in pre-war days in Sydney and Melbourne markets, Indian carpet wools were being knocked down at 6 to 8 pence per lb. in the Liverpool auctions. Must then Indian sheep breeders be always relegated to the production of the cheapest stuff and must must their poverty be perpetuated ?

Occasional desirable specimens

Attention has been drawn to the fact that some specimens of good wool producing individuals are occasionally met with here and there and it has been recommended that they should be developed into a fixed breed by selective breeding. The first point to be examined in this connection is whether the number of such desirable individuals met with in an area is sufficient enough to allow a flock of even an experimental unit to be set up. The other point equally important is whether the useful characteristics so observed are, within a reasonable range of variation, common in that area. There may be a sheep having fine but medullated fleece, another sheep may be free from medullation but the wool may be coarse, there may be yet another specimen in which the presence of kemp may be nil. If a flock of such different characteristics is built up and inter-bred, it is very likely that the progeny will have a majority of all the undesirable characteristics. In fact the throwing up of specimens here and there with different desirable characteristics is merely an end product of a series of reactions going on in nature. The writer has already shown that the percentage of such rare specimens is very low—4 to 5 at best.

It is agreed that a number of laboratories should be set up for carrying out physical analysis of wools and the points referred to above should be thoroughly investigated. It should be definitely established that certain useful characteristics, observed in a specimen in a given area, are met with in varying degrees, in a large number of sheep of that area ; this would show that these qualities are a result of environment or heredity, or interplay of both, and therefore have the potentialities of development. If after that a judicious selection is made from the stock of that area, in which all the particular characteristics observed are present, and a flock is built up and inter-bred, then not only substantial but also quick results would follow. These efforts should be made where it is possible to develop breeds of sheep which would yield wool of good quality. It would bring good returns to sheep owners and develop the wool-manufacturing industry of India—both cottage and mill.

It has also been suggested that a woolly type of sheep should be evolved from hairy and nondescript types of sheep. We shall have to wait until doomsday till that type is evolved and fixed. Failing that, it has been suggested that cross-breeding the nondescript type with some well-known Indian breeds, which produce the ideal type of carpet wools, should be practised. The writer would like to know which is that breed of sheep in India which produces the ideal type of carpet wool and *breeds true to type?* It has been recommended that this mongrel, a cross of hair with carpet wool, should be developed into a clothing type of wool-producing sheep. This breed should then be used for cross-breeding. It is obvious that this line of breeding will introduce too many undesirable genes which will be difficult to eliminate and the breed will never be able to breed true to type.

'No plan is likely to be successful until the cooperation of the ordinary breeders is forthcoming and he is not going to fall in with any scheme unless he actually obtains a premium on his better quality of wool '[1]. But what better quality wool is the breeder advised to produce ? Carpet wool or at best poor quality clothing wool of 42 to 46 counts. Will slightly better returns, which he might get as a result of producing the 'ideal type of carpet wool' or ordinary clothing stuff, be commensurate with the extra botheration and the official supervision with all its concomitant hardhsips that will be inflicted upon him in the course of this whole scheme ? Will it evoke his whole-hearted enthusiasm ?

It is submitted that the last war has given a

[1] Note presented to the Animal Husbandry Wing of the I.C.A.R.

tremendous impetus to the manufacture of cheap artificial fibres particularly as a substitute for wool, and the progress that has been made is likely to seriously threaten the entire natural wool-producing industry. In the face of such threatening clouds, to gear the Indian industry for the production of cheap carpet or clothing wools is to meet disaster halfway.

HIGHEST WOOL PRICE SOARS TO 99½d.

THE Australian record price for greasy wool was broken at the sales in Melbourne recently when 99½ pence a lb. was paid for a bale of extra superfine combing wool.

This is 20 pence more than the previous Australian record wool price, paid at Geelong early this month.

Australia's pre-war record—also a world record—was 53½d. paid in the 1924-25 season.

Prices for superfine wool have been soaring in the last few weeks.

Less than two months ago the highest price at Sydney sales was 48½d.—*Austral News*, January, 1947.

JOHNE'S DISEASE IN CATTLE

By G. L. SHARMA

JOHNE'S DISEASE is a chronic inflammation of the bowels caused by a specific bacterial infection. It is characterized by intermittent or persistent diarrhoea accompanied by gradual emaciation. In most cases the infection ends in death. It mostly occurs in cattle and buffaloes and sometime among sheep and goats as well. First recognized about half a century ago, the disease today is prevalent throughout the world. It is known to occur almost throughout this country, the incidence varying from place to place and when compared to that of other infectious diseases of stock, the disease is rather rare, scattered and sporadic.

Owing to its comparatively rare and insidious appearance, the stockowners are apt to view this infection with complacency. But its subtle methods of spread, the havoc it causes in the herd, and the extreme difficulty of its eradication in the absence of a known cure, render an outbreak an enduring calamity. On account of the mildness of the symptoms in the early stages, the disease is rarely recognized until it has attacked a number of animals, when it manifests itself at the first instance by reducing the milk yield of valuable cows and by seriously impairing the working capacity of draught animals and later by mortalities. So that, while the infection of a virulent disease like rinderpest, which can be avoided by immunization, constitutes a grave but quickly passing menace, that of Johne's disease, against which there is no satisfactory method of immunization, when once established, is bound to cause a steady drain on the owner's resources. Further, the more the disease is allowed to spread the greater will be the eventual loss to the Indian agriculture as a whole.

Cause and method of infection

A microscopic germ called Johne's bacillus, is the cause of the disease. The germ multiplies in the bowel and is voided by the infected animals in their dung, where it may survive for months. Pastures, water supplies, and wallows become contaminated by this dung and become sources of infection. Calves often get infected by licking the soiled hind parts of their dams. The infection is contacted by mouth. The most susceptible animals are calves of less than six months of age. The circumstances which may favour infection or the flaring-up of a latent infection are noted below

Calving: Although the infection is usually acquired in calfhood, the actual symptoms often appear later in life after the second or the third calving. This has been ascribed as due to (a) the drain on an already infected system to provide for the growing foetus, (b) the strain of parturition, and (c) the sudden activity of milk gland.

Debilitating factors: Factors such as infestation of parasites, particularly of the bowel, housing of animals in dark, ill-ventilated sheds and deficient feeding, specially in minerals, lower the natural resistance against the infection and predispose to a rapid spread of the disease.

Symptoms

Once animals (usually calves) have become infected, it is uncommon for the symptoms to appear before a lapse of one or two years. The cases are, however, known where year-old animals have shown the symptoms.

With the onset of the disease the affected animal starts losing the gloss of its coat. In due course it voids loose dung which later turns to profuse fluid diarrhoea often containing, in severe cases, gas bubbles and flakes of mucous membrane or a tinge of blood. If the affected animal happens to be a milking one its milk yield at this stage would start to decline and its general condition would show gradual deterioration. The animal becomes thirsty but does not show any sign of fever. Under these adverse conditions, even up to the time of death, it retains its appetite. The symptoms once commenced usually go on progressing, but there are cases in which symptoms often disappear to recur anew. Many infected animals go through their lives without showing pronounced symptoms, while others run the full course of the disease and die in a state of extreme emaciation.

G. L. SHARMA is connected with the Indian Veterinary Research Institute, Mukteswar.

Diagnosis

It is of paramount importance that animals infected with Johne's disease are identified before the symptoms appear, because with the onset of diarrhoea pastures become contaminated and other healthy animals fall victim to the infection. To detect the infected but apparently healthy animals, use is made of a test which is somewhat similar to that used in diagnosing tuberculosis. A small quantity of a preparation known as Johnin is injected into the skin of the neck of suspected animals twice on the same site at 48 hours' interval. In diseased animals, the skin about the point of injection shows a gross swelling, whereas in healthy animals there is slight or no swelling. The test, however, is not entirely successful because some animals do not fully respond to it and as such it is difficult to state whether they are infected or not. These so-called suspicious non-reactors should be retested after suitable interval. The alternative method of diagnosis consists in actually identifying the causal organisms when the symptoms are at their height. The identification is carried out by microscopical examination of the dung, or of the bowel washings, or of small portions of the bowel wall pinched off with the finger-nail. This diagnosis is actually the work of a veterinarian but even owners, by a careful watchfulness for cases of intractable diarrhoea with persistent loss of condition and by an early appeal to the veterinarian, can do much towards avoiding a threat of this formidable disease.

Treatment

While many methods have been advocated for curing Johne's disease, none can really help except protracting the illness and thereby keeping alive the dangerously infective animals. All these methods are therefore to be condemned. Besides, it is an economic waste to keep these diseased and unproductive animals alive by providing feeds which can be more usefully utilized for the healthy animals. However, in certain circumstances, such as in an attempt to fatten for beef or to obtain a last valuable calf it may be desirable to prolong the life of the infected animal. The means adopted to do this are given below.

Animals suffering from the disease should be segregated under hygienic conditions and fed on easily digestible nutritious food.

To check the diarrhoea one of the following mixtures may be administered :

(1)	Ferrous sulphate ..	5 ounces
	Dilute sulphuric acid ..	5 ounces
	Water sufficient to make 1 pint.	

One ounce of this mixture in one point of water should be given daily for five to six weeks.

(2)	Opium ..	½ drachm
	Catechu ..	2-4 drachms
	Prepared chalk ..	½ to 1 ounce

Mixed in flour or rice gruel, this can be given twice a day in case of profuse diarrhoea.

Intestinal antiseptics such as salol (2 drachms), once or twice a day, may be tried.

Prevention and control

In the absence of any satisfactory curative treatment suppression of infection is the only course open to the stockowner. All animals showing the symptoms of persistent or intermittent diarrhoea, with gradual weakness in spite of good appetite, should be segregated and examined for the cause of the abnormality. If Johne's disease is discovered, then a plan based on the following lines should be launched to control and prevent the spread of the disease:

(1) The clinical cases should be identified either by the symptoms shown or by actually finding out the causal bacteria in faeces. These animals should preferably be slaughtered, failing which, they should be rigorously isolated until death. The sheds occupied by diseased animals should be thoroughly cleaned of the soiled litters, the floor being washed and scrubbed with phenyle solution. The soiled litter is preferably burnt or spread on cultivated land to which cattle have no access. The pastures on which the infected animals graze should be ploughed up and left vacant for at least a year.

(2) The rest of the herd should be examined by the double intradermal Johnin test and divided into two groups, namely (a) reactors and (b) non reactors or healthy animals. These groups should be kept in separate yards and should be allotted separate pastures.

(3) Reactors should be carefully watched and any animal developing clinical symptoms should be slaughtered or isolated with the previously segregated lot.

(4) After the first test, the healthy herd should be retested every six months to discover any fresh reactors, which should then be removed to the reactors' group.

(5) Calves born of reactors should, if possible, be weaned immediately after birth, otherwise they may be allowed to come in contact with their dams only at the time of suckling. These calves should be tested with Johnin at the age of six months and again at one year. Those passing the tests and looking apparently healthy may be transferred to the healthy herd.

(6) Fresh clean water should be arranged for the animals, and ponds and stagnant pools should be fenced off. If Johne's disease is prevalent in a district, new purchases should be made either from an area which is known to be free from the disease, or the newly purchased animals should prove non-reactors to Johnin test.

(7) The general resistance of the healthy herd should be sustained by (a) getting rid of intestinal parasites, (b) by providing them with hygienic housing, and (c) by feeding them on adequate diet.

PENICILLIN FOR MASTITIS

WHEN supplies are sufficient, penicillin is likely completely to cure mastitis in dairy herds in Australia. This is the opinion of Dr A. W. Turner, in charge of the Animal Health and Products Division of the Australian Council for Scientific and Industrial Research. The division has been carrying out research work at the Parkville laboratories (Victoria) and at field stations, with spectacular results.

The effect of penicillin on 'carrier' animals has been an outstanding gain, says Dr Turner. One animal treated with penicillin at Tooradin field station, Victoria, had given only a small quantity of milk of a yellowish colour. Four days after the drug had been administered, the heifer delivered a normal supply of milk free of the germ.

Research work on mastitis in dairy cattle has been in progress for many years, largely financed by the Australian Dairy Cattle Research Association.—*Australian Agricultural Newsletter*, Release No. A.G.N. /135.

MANGO PROPAGATION METHODS AT FRUIT RESEARCH STATION, KODUR

By K. C. NAIK

INARCHING in the case of superior varieties and seed propagation in the case of others have been the commonest mango nursery methods in India for centuries. Owing partly to regional variations in regard to climate and partly to the individual preferences or fancies, these propagation methods as practised in the country do not at all conform to a standard. In particular, the variations are particularly marked in regard to the season of operation, the age of rootstocks at the time of inarching, the time of operation and the manner of nursing the grafts after separation from the scion parent.

Inarching, though easy in practice, is a more expensive method than budding or other methods of grafting, in which the scion shoot is entirely separated out from the mother tree before inserting on the rootstock. Of late, therefore, increasing attention has been given in many parts of the country to the devising of a more economic and convenient method of propagating the mango than inarching.

Till recently it has been widely believed that the Indian mangoes are all mono-embryonic and therefore produce highly variable material. The polyembryonic races or varieties, which are capable of giving pure lines of vegetatively produced descendants were believed to be non-existent in the country so that seed-propagation was deemed impossible for raising plantations of known varieties.

Inarching, as is commonly practised, involves therefore the union between a variable seedling rootstock material and the scion material from a known superior parent. The practice of double working, in which a stem-piece of a known variety is inserted between the variable seedling rootstock and the scion of the superior parent, has been claimed in other countries to contribute to great uniformity in orchard performance, besides possibly transmitting to the ultimate scion some of the desirable characteristics of the intermediate stem-piece. Such double working was not, however, attempted previously anywhere in the country in order to assess the value of the method.

To elucidate these various problems and to standardize and improve the mango propagation methods, work was initiated in 1935 at the Fruit Research Station, Kodur, and this has been in progress since then. The results obtained from these investigations are believed to be of sufficient interest and value to merit their dissemination to those in the line in all parts of the country.

Seed propagation

A seedbed of good tilth and free from any obstruction in the path of the developing shoot of the seedling is found necessary to avoid crooked stems, which render the seedling unfit for use as rootstock. Distorted roots caused by the presence of any hard material in the soil media, such as stone pebbles, are also undesirable, as plants with such defective roots transplant poorly and suffer damage in the course of lifting from the seedbed to the pots.

Of the several methods of sowing the stones, it is found that shelling of the stones prior to sowing is useful to eliminate diseased or worm-infested kernels and to foster straight taproot and stem. Such seeds also germinate on an average 12 days earlier than unshelled stones. As against these merits, shelling results in about 14 per cent less germination than in unshelled stones, possibly due to damage caused during the shelling operation, and is also more expensive owing to the higher cost of that operation. It seems therefore doubtful if the Indian nursery trade will resort to shelling on a commercial scale, despite certain advantages associated with it.

Grading of stones according to size of fruit and of stone is found unnecessary, as high germination does not invariably possess a positive correlation with larger stone or fruit size.

Of the five methods of sowing tried at Kodur in respect of seed position in the beds, sowing

K. C. NAIK, M. Sc. (Bristol), is Fruit Specialist to the Madras Government.

the stone with plumule up is found to produce a straight taproot and stem on a larger number of plants than by sowing flat, or with suture up or suture down or with plumule pointing downwards. The first method is now being used exclusively at the Kodur Station nurseries with obvious advantage.

Vigour of growth in seedling is found to vary markedly between the progenies of different seed-parents; this shows that the inherent vigour of these seed-parents is an important factor that deserves to be exploited in the interests of economy. The selection of seed-parent is therefore a step in the right direction.

Contrary to the wide-spread belief that mango seedlings at the nursery stage do not lend themsleves for lifting with naked roots, it is now known that exposure of roots for a short duration of a few hours at the time of transplanting is not detrimental to the life of the seedlings, provided the operation is done in a cool and humid evening, when the growth is apparently inactive. It should be possible for each nursery to determine the optimum season for the operation and thus effect some saving in production cost. From a series of trials it has also been ascertained that lifting seedlings seven to nine days after heavy defoliation, with only a couple of leaves retained in the terminal rosette, reduces the mortality of such seedlings to a great extent even during the hot and dry periods of the year.

Against the common practice of watering the potted seedlings daily, it has been found possible at Kodur to prolong the irrigation interval from three to five days, by keeping the potted plants close together in a trench to which water is let in in a manner to fill it up to the edge of the pots.

Polyembryony

A number of mango varieties grown in the west of South India have been found to be distinctly polyembryonic in the tests made at Kodur. Among these, the maximum of five seedlings per seed-were obtained in Kurkan, four in Bellary, Olour and Goa, three in Neelaparanky and Mylepelian, and two in Chandrakaran, Muvandan, Salem and Kambran. Bellary, Chandrakaran and Mylepelian varieties have produced the best germination of all these polyembryonic mango races.

Inarching

At a very early stage of these studies it became clear that inarching of young seedlings of even less than 4½ months of age was possible but there was little or no demand for such tiny grafts. From a trial of seedling rootstocks of three commonly used age groups (10½ to 16½ months), it is now possible to say that there is no difference between these in respect of tree growth and performance. This leads to the conclusion that 10 to 16½ months old seedling rootstocks are best used for inarching when the inarching season is at the optimum. This has been determined for Kodur to be July to September. Among the two commercial varieties tried, Neelum as a whole contributes to a greater success by inarching than Bangalore. It has to be remembered, however, that variation in weather conditions from year to year may and do influence the suitability or otherwise of any season for the operation.

Different varieties seem to also demand different length of time from inarching to separation stage. For instance, for Rumani scion variety a four months period is found necessary, while three months seem to suffice for Neelum and Bangalore.

Grafts raised by inarching can be successfully depotted and planted out in their permanent sites immediately after separation from scion parents after four months of inarching provided the season for the planting is suitable. It does not therefore seem necessary to nurse the grafts for long periods after separation, as it is widely believed to be necessary.

Other grafting methods

Root grafting : Since a commercially successful method of vegetative reproduction of mango rootstocks is yet to be devised, some means of obtaining uniform rootstock material with a miscellaneous seedling basis is found to be necessary for experimental purposes. Workers with other fruits have also pointed out that a stem-piece of the rootstock often masks and outweighs the influence of the absorbing root-system. If, therefore, only the root piece of the seedling rootstock is grafted to the scion, the stem influence of the rootstock will be eliminated; and it should thus be possible to obtain a uniform material for field trials. In an evergreen fruit like the mango, the success of the method will naturally depend upon the

ability of the seedling to withstand exposure of root during the root-grafting operation, on the ease with which the root piece can be grafted, and perhaps also on the season of operation as well as the age of the rootstock and scion. After a series of trials to elucidate these various problems, a successful method of root-grafting in mango has been devised at Kodur. The operation consisted of lifting about one year old seedlings from the beds with ball of earth around the roots, potting the same in containers having a U-shaped notch (1 in. wide and 2 in. long) in a slanting manner so as to keep the collar of the seedlings close to the U-shaped notch, exposing the root-piece near the collar to a length of about three inches and making this exposed three-inch root-piece to protrude out through the U-shaped notch. The potting and the connected operations are best done in rainy season. About a month after potting the grafting of the scion shoot to the exposed root-piece can be done successfully. When grafted in August, the percentage of success has been as high as 100 in 1937, while it was 93-97 per cent in those grafted in July, 1939. Root-grafting therefore is found to be a feasible operation even though some casualties in seedling stocks might occur at the time of potting and during the slight exposure of the root-portions. While the method cannot be advocated in commercial nursery practice, its value for raising uniform plant material on a miscellaneous seedling basis from mono-embryonic seed parents is likely to be great.

Budding: Six different methods of budding the mango have been experimented upon at Kodur. From the early trials in 1937, it became clear that budding offered a good chance of becoming an established nursery practice. The most successful method, which gave over 62 per cent success in the earlier trials, was the one described below.

A transverse incision was made in the bark of the seedling rootstock of about 12 months of age, in beds in June, as far as the cambium. The bark was then peeled down to a length of about 1½ inch after making two vertical parallel cuts connecting the two ends of the transverse cut. The peeling has to be done carefully, so that it may come out in one strip. The bud-shield was removed in the same manner as in oranges from the scion shoot, with a small piece of wood attached to it, and this was pushed under the flap till all the exposed edges of stock rind and bud-shield were in perfect contact. This is only possible if the size of the bud-stick is the same as that of the stock stem. The flap was then brought into position and made to cover the bud-shield completely. The covered bud was then wrapped around with paraffined cloth and finally with a piece of dried banana sheath.

Equally high or even greater success by budding was secured in the later years, with the highest success, viz. 83·56 per cent, with Neelum scion variety budded in July, 1939 on about 12 months old stock by the ordinary shield method and 79·45 per cent by patch method.

Side-grafting: A method of side-grafting old seedling or uneconomic trees is already known in South India, and has been described by the author[1]. But side-grafting as a nursery practice was never known in the country till the trials at Kodur proved their efficacy. This method is identical to that devised by Nakamura[2] and has given unexpectedly great success with several scion varieties at Kodur over a number of years, beside proving to be very easy and economical in practice. Mature scion wood representing about one year old growth, from the apical regions of the shoot of the scion trees should be selected during an intermittent rest period between two cyclic growths, and these should be pre-cured by defoliation of the selected shoot up to about three inches from the apex, to leave only the leaf stalks. Only scion shoots which are found to be cylindrical and plump, with shoot-diameter of not less than 0·5 cm., are suitable for the operation. The defoliated parts of the terminal scion shoot are cut off clean with a sharp knife five to seven days after curing and their basal portions are prepared into a wedge shape with one side cut slightly deeper than the opposite side as explained by Nakamura[2]; the prepared scion shoots should be inserted on 12 months old seedling stocks in beds, taking care that the stock stem circumference is the same as that of the scion shoot. Alfonso, Neelum, Alampur Baneshan and Baneshan scion varieties, when side-grafted from September to November in 1945, gave as high success as 80 to 100 per cent at Kodur. With thinner

[1] *Madras Agricultural Departmental Leaflet* No. 100, 1942.

[2] Tanaka, Tyozambura (1939). *Philip. J. Agric.* 10

scions inserted on weak seedlings of dissimilar stock stem-girth in dry periods of the year as well as with some scion varieties like Peter, the success by side-grafting is found to be relatively low.

Other vegetative methods

Cleft-grafting as well as rooting of mango cuttings have also been tried at Kodur, but the success obtained with these processes being extremely low, it is considered unnecessary to describe them in these pages. Double-working, however, has been found to be an easy and convenient operation, when performed by the ordinary method of inarching in pots in almost any period of the year. Observations so far made indicate that double-working on a productive variety like Neelum as the intermediate stem tend to produce slightly dwarfed trees but with precocious and prolific tendencies. Etiolation of shoots with or without cincturing and mound layering have also been tried but none of these succeeded in inducing the mangoes to root.

Conclusion

Inarching of mango is a practice that has made such a strong hold in this country that any other method may not easily appeal to growers and nurserymen, unless the benefits of the new methods are clearly brought out. From a trial of all these various methods of vegetative propagation at Kodur over a number of years, it has been shown that side-grafting can be a more effective, economical and convenient method in mango nursery practice at least with some scion varieties. Before this method is advocated in all parts of the country, it will be necessary to determine the scion varieties and season suitable for the operations at the optimum level as well as the best method and season for lifting out the successful side-grafts from the nursery beds. The last mentioned is not, however, a problem when it is intended to do side-grafting *in situ*. Next to side-grafting, budding of mangoes has been found to be a useful method, particularly when the operation is to be performed *in situ* as in side-grafting, and the transplantation of the successful budling or graft to a new site is not involved.

With the information now available about the existence of a number of polyembryonic mango varieties in South India, the problem of variability in seedling rootstock need not any longer cause concern to mango field investigators. Where mono-embryonic seed materials are only available, root-grafting can be resorted to in order to reduce or eliminate the variability in rootstock material from such heterozygous seed parents.

There is some indication available at Kodur that polyembryonic rootstocks impart better scion vigour than the mono-embryonic stocks, that older grafts need not necessarily lead to better orchard performance than younger grafts and that double-working imparts precocious and prolific bearing tendencies to the scions double-worked on productive varieties as intermediate stem pieces, though such double-worked plants are likely to produce rather dwarfed scion trees. These features would be of especial value in improving the yielding capacities of naturally shy-bearing but choice-fruiting varieties by double-working them on inherently productive varieties, like Neelum, as intermediate stem, if the foregoing observations are confirmed in future years.

Acknowledgement

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BARODA WOOL-GRADING AND MARKETING EXPERIMENT

By N. L. NARAYAN

PREPARING the wool crop for the market is one of the most important jobs in a sheepman's calendar. Even where production of mutton is the primary object, the wool crop is said to bring in about 30 per cent of the income. And for the stationary sheep farmers of north Gujarat and Kathiawar, who usually do not raise sheep for slaughtering, realizing the full value of the wool grown is of utmost importance.

Two ways of selling the wool crop are in vogue in these areas: (1) selling the wool on the sheep's back, the rate being fixed on the number of fleeces; and (2) getting the sheep shorn by engaging labourers, and carrying the wool to the nearest merchant for sale, the rate being fixed on weight. In the former case the cost of shearing and transport is on the buyer and in the latter on the producer. Of these two methods, the former is the most common on account of the small-sized flocks reared in these areas. The responsibility of making the most of the wool grown and passing on a fair proportion of the value received to the producers according to quality and quantity of production rests on the merchants or the collecting agency.

No hard and fast rule can be laid down for collection of wool in general. The procedure to be adopted depends on various local factors, such as:

(1) Existing breeds of sheep

(2) Wool types of different breeds

(3) The number, distribution, and proportion of different breeds and types of sheep

(4) Regional and individual variations in wool quality within each type

(5) Labour and transport facilities.

A thorough survey of the area with regard to these points will be helpful in determining the most suitable and economical lines on which wool can be collected, how far grading should be undertaken at the shearing yard, and how many lots it would be profitable to make in view of the quantity of wool grown and the needs of the market.

N. L. NARAYAN, G.V.Sc., holds the position of Wool Improvement Officer in Baroda State.

The sheep area in north Gujarat (Mehsana district and surrounding areas) was found to be stocked with mostly a fine-woolled type of sheep known as Pattanwadi, though other breeds were existing in small numbers. The bulk of the wool produced, therefore, was of the clothing type, and indicated possibilities of being classed into different grades on the basis of fineness, feel and purity (medullation). Consideration of other characters like length would reduce the bulk of the lots without in any way increasing their value. Taking into consideration the variations in wool quality of the whole tract, three distinct classes were possible of white and two of coloured wool. Test samples of the superior classes were highly appreciated by manufacturers and higher prices were assured if large quantities of the same standard could be obtained.

Against these promising findings were the drawbacks in other directions. The number of sheep on an average in a flock was 50 and in a village 100. Even different breeds of sheep were common in a flock. The wool sales were beset with fraud on both sides, producer as well as the purchaser. The method of collection was the crudest possible. Several fleeces were placed one above the other and these got so mixed up that it was impossible to do any other sorting except on colour at the godown. When it is borne in mind that entirely different breeds, from the fine-wooled Pattanwadi to the completely hairy Chanotri, are often found in a single flock the wide variation in quality and type of the mixed collection will be realized.

The important point to note was that even the wool so-called was noted for its fineness in the market as *joria* on account of the large proportion of fine wool in it. The collecting merchants were either ignorant of the fact or did not believe that the introduction of better methods of collection was necessary or that it would pay.

To study the above question, a large scale wool-grading and marketing experiment was undertaken by the Government of Baroda in 1942, along with other developmental activities

FIG. 1. Pattanwadi sheep showing depth of the staple

FIG. 2. Village sheep washing

PLATE 7

FIG. 3. Packing wool

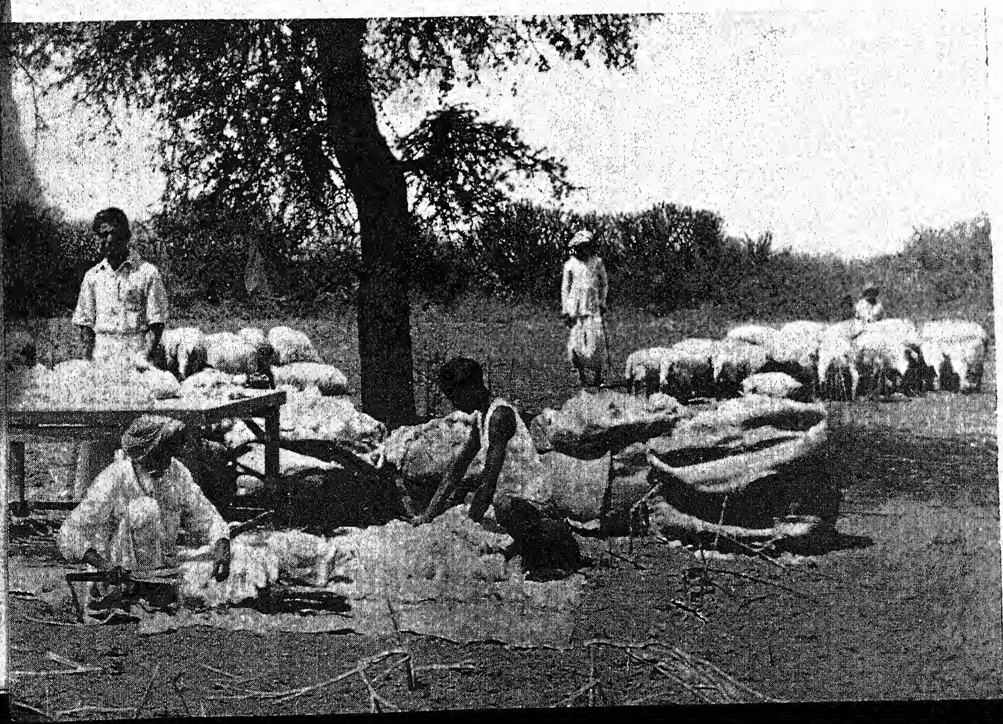


FIG. 4. Shearing and grading at one of the centres

for sheep development in these areas. The general principle was to purchase the wool on the sheep's back at the current rates, shear, grade, clean and sell the wool, and return part of the profits to the owners from whom the wool was purchased.

Organization

The area most heavily stocked with Pattanwadi sheep in Mehsana district was chosen for conducting this experiment. According to the number of sheep and other local conditions this area was divided into different divisions with about 5,000 sheep per division. A supervisor was placed in each division, who visited all the important villages, contacted the sheepmen and conducted propaganda on behalf of the Government.

Two months prior to the shearing season these supervisors were provided with money for distributing advances on the coming clip to those who promised to sell their wool crop to the Government according to the local custom. Convenient shearing centres were chosen, the number depending on the total number of villages where sheep were booked, the rate being about one centre for six villages, and a detailed programme was drawn up fixing the time and place for shearing the sheep of each owner. Information was sent to the owners, a fortnight earlier than the shearing date, about the time and place of shearing. Washing of sheep was quite common in these areas and was always carried out.

Meanwhile shearing teams were formed, each consisting of a grader and four shearers engaged temporarily for the season. Other labourers like shed hands and piece pickers were employed locally at each centre. Each team was equipped with a skirting table, a big piece of cloth on which the sheep were to be shorn, gunny bags, needles and stationery.

The shearing period was about one month within which all the sheep booked were shorn. Each team in charge of the local supervisor moved from centre to centre as planned before in a definite area assigned to it.

Grading

As each sheep was shorn the shed hand picked up the fleece, holding the margins, and placed it on the skirting table with the body side below. The grader first skirted the coarse and dirty edges, which were packed separately as 'skirtings'. The coloured part of the fleece, coming from the neck region, was next separated and collected as 'colour'. The remaining white part of the fleece was usually divided into three parts: (1) withers, long and comparatively coarser, (2) side, back and shoulder, the finest parts of the fleece, and (3) breech, short and coarsest. Each of these parts was placed in super, first or second grades according to quality. It was here that the grader displayed his skill in grading. Different grades of wool thus collected were packed in bags and carted to the godown at the head office, before the team moved on to the next.

The shearing period seldom went off as smoothly as it was planned. Many difficulties came in the way on account of competition from other collecting agents and the sheep owners failing to turn up with their sheep in time. These difficulties had to be overcome by suitable alterations in rates and programme.

After the shearing was completed the wool at the godown was deburred, cleaned and packed in bags by engaging labourers. Offers were called for by sending samples to various commission agents and mills, and the wool was sold to the highest bidder. Higher prices than those current for ungraded wools were secured for the graded wool of all the seasons. All expenses incurred including those on temporary employees, transport, clearing, packing, godown rent and labour were put on the wool and a balance sheet was made up. Here are some of the figures for the four clips completed by the Government.

	1942 Spring	1942 Autumn	1943 Spring	1943 Autumn
No. of sheep tackled	11,751	14,913	31,879	32,092
Net profits	Rs. 1484	Rs. 2237	Rs. 1688	Rs. 6025
Average price per lb. of graded wools	As. 14	As. 14-6	As. 14-4	As. 14-5
The same for ungraded wools	As. 10-5	As. 10	As. 10-5	As. 10

Out of the net profits the owners were paid a bonus of 25 per cent over the current rates,

and the remaining sum was credited to the Government. Experts in the line described the super class as 'approaching 56s clothing' and the first as '36/38s clothing'. The purchasers were able to manufacture high class woollen tweeds out of the top grades. Laboratory analyses of the top grades showed that the variations in fineness and medullation could be restricted to a narrow range, in spite of the number of graders employed. Special 'Agmark' specifications were fixed for these types based on these values.

With these successful results, it must be stated that the overhead expenses—pay of permanent supervisors—were not included in the cost of production. The part of the profits that was credited to the Government was meant to cover this, and though it was not found possible to do so completely in the beginning, it came quite close to it in the last season.

The handicaps of introducing grading on commercial lines are:

(1) The cost of collection will be increased

(2) Grading in the beginning will not be as efficient as expected

(3) Buyers, who will be prepared to pay a higher price for graded wools in proportion to the increased cost of collection, will be limited until confidence is gained that the bulk of the wool is up to the specified standard. (This can be met to a considerable extent by Agmarking).

The above experiment proved that these difficulties could be overcome by experience and increased output and that the introduction of better methods of collection could be made profitable both to the producer and to the collecting agencies in the long run. Following this experiment a commercial concern, the Indian Wool and Pastoral Development Company Ltd., has come into being to handle wool on similar lines on a larger scale in these areas.

WOOL CLIP ESTIMATE

THE Australian current season's wool clip is expected to be 3 million bales, exclusive of skin wools. Merino wools are expected to be 77 per cent of the total. Average bale weight will probably be 305·6 lb.

Last season's clip, the poorest for many years, was 2,891,754 bales, valued at Rs. 61,95,00,000. The 1943-44 clip of 3,606,547 bales was sold for Rs. 80, 46,00,000.—*Australian Agricultural Newsletter*, Release No. AGN/135.

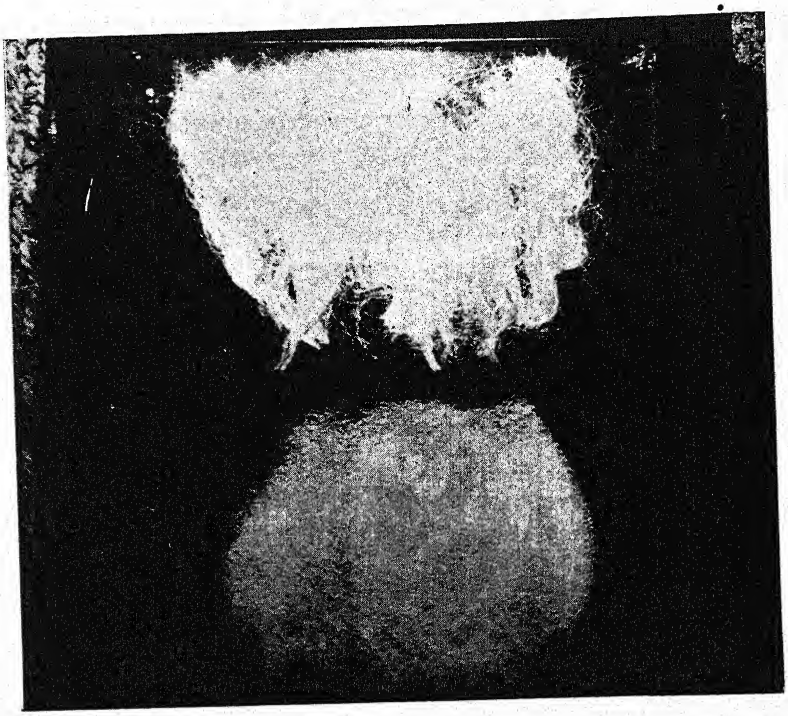


FIG. 5. Pattanwadi wool (top) and Chanotari wool (below)

FIG. 6. Deburring of wool

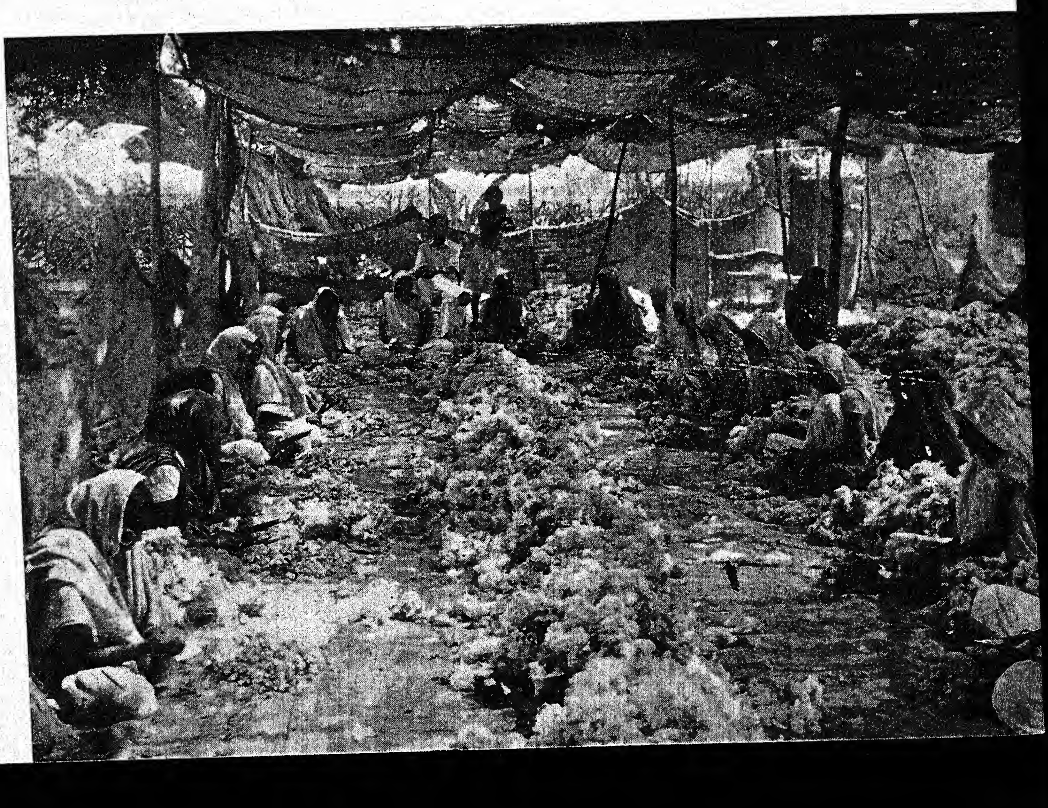


PLATE 9

THE UTILIZATION OF WATER HYACINTH

By E. F. WATSON

FEW people who have this weed on their land realize its potentialities. It is a wonderful plant, trapping the sunlight to build up immense stores of cellulose and intercepting the soluble salts washed out of the soil and storing them in its tissues.

But to appreciate it one has to learn to appreciate compost. Properly made compost is not merely a bulky manure that will give to the soil the humus it so badly needs; it is full of life in the shape of soil bacteria who depend on this humus for their existence and who in turn convert it as well as any humus already in the soil into the materials that plants can take up as food. It should therefore be used as an inoculum rather than a repository of required chemical elements. This is why light dressings given at the time of sowing are so much the most effective way of using it.

The problem is how to make from water hyacinth a first class compost. A study of the Indore method shows the following essentials. A compost heap should be so made that a temperature of at least 140° F. should be rapidly attained and all seeds and parasites destroyed. To ensure this temperature, it is essential to have some base, such as soil or wood ashes or mortar rubbish to neutralize the resulting acidity, which otherwise puts a stop to the fermentation process.

The heap must have sufficient air to supply the oxygen needs of the aerobic bacteria that initiate and continue the process and sufficient moisture without which action ceases.

Bearing all these in mind it should be noted that water hyacinth should not be composted in the fresh green state, otherwise it will settle down into the sort of soggy mass that we see when it is piled on the edges of tanks. Nor should it become bone dry as that would necessitate getting it all moist again. If when removed it is spread out in a thin layer to wilt in the sun for a week or two, it will be just about right. Even then to avoid its compacting into a solid mass through which air cannot penetrate, it is always best to mix some other material such as rough dry grass, wilted jungle or fallen leaves with it.

The simplest way of making compost in the first instance, and until one understands the process sufficiently well to tackle it on a large scale, is to use a circular framework made of bamboo. A convenient size is 5 ft. diameter at base, 4 ft. high and 4 ft. 6 in. diameter at top. This taper is to enable it to be lifted off without sticking. This should be put up on a plot of well-dug earth and roughly mud-plastered inside except for the bottom six inches; this is to prevent strong winds blowing through it.

The well-wilted water hyacinth, together with any other vegetable refuse available, is spread evenly in a layer about 9 in. thick. Over this a layer of any fresh manure is put an inch or more thick; urine-soaked bedding is best of all. Then a layer of wood ashes or finely powdered earth is evenly scattered over the whole; that obtained from the scraping of cattle stances or the cleaning of drains is the best but it must be dry and finely powdered to spread evenly.

Turn over the whole two or three times to get it thoroughly mixed. Every leaf should have a little manure and a little earth adhering to it. Then stick a 5 ft. bamboo lightly into the ground in the middle of the bamboo framework and toss all the material in round it, piling up as much on the top as can be managed to stay. Leave for four days (by which time it should have settled to half the height) and remove the central bamboo stake, the bottom of which should be too hot to touch if the material has been mixed properly.

The aeration hole thus left will start smoking at once. Failure to heat up generally means that the material has been mixed too wet which helps making silage instead of compost. If this is the case lift off the bamboo framework, spread all the material out for an hour or two to dry a little and then refill as before. The heap should continue steaming for a fortnight and then slowly cool down. If it cools too quickly, it probably indicates stinted wood ashes and earth.

E. F. WATSON is the Superintendent of Governor's Estates in Bengal.

After 20 days the framework can be lifted off and set up alongside while the still hot material (which should now be completely covered with grey fungus mycelium) is mixed and reloaded in it. Any over-dry parts should be put in the middle this time and over-damp parts round the edge. The bamboo pole should be put in as before and removed after four days. In another 10 days the framework can be removed altogether and used again for starting a fresh compost heap.

The first made heap should be left two months to ripen, after which (three months from the start) it will have become a brown friable compost ready for immediate use. Nothing needs to be done to it during this time beyond an occasional light watering of the outside, should the weather be very dry. If not wanted at once it should be stored under cover or the tops of the heaps made conical and covered with a little earth to ward off heavy rain.

If the compost first made is applied to one half of a man's field in the first instance and the other half left as a control, no further persuasion will be necessary to get the ryot to take up the process. The benefit on the crop will be there for all to see.

I have known enthusiasm to be so great that not enough water hyacinth was left to continue future growth!

MILL SLUDGE AS FERTILIZER

A 250-acre dairy farm in Tasmania, Australia, has had its carrying capacity increased from 45 to 200 cows by sludge pumped from paper mills and then dispersed by irrigation channels. The sludge was previously spoiling water for landholders further down the stream.

The sludge is residue after straw has been 'cooked' for eight hours, and looks like black liquid mud. It is diverted into eight miles of intricate channels, and dispersed for soil building. In 1937 it was directed over a useless stony outcrop which today is completely covered and carrying deep grass.

The only weed the sludge has not exterminated from the property is artichoke thistle. In 13 years only four cases of sick stock have been noticed.—*Australian Agricultural Newsletter*, Release No. AGN/135.

SCOPE FOR THE UTILIZATION OF HUMAN URINE AS MANURE

By M. A. IDNANI

THE waste matter of human habitations constitutes valuable raw material for the production of manure, which may find useful application in agriculture. An estimate of the total potential supply of manurial ingredients in our habitation wastes is given in Table I.

TABLE I

Potential supplies of manurial ingredients (Population 400 millions)

	Dry matter	Organic matter	Nitrogen	Phosphoric acid	Potash
	in million tons per year				
Night soil ..	4·9	3·4	0·35	0·23	0·10
Urine ..	9·3	5·7	1·70	0·26	0·32
Street refuse	40·0	20·0	0·32	0·12	0·80
Total ..	54·2	29·1	2·37	0·61	1·22

It will be observed that urine constitutes by far the richest single fraction of these wastes, contributing 1·7 million tons of nitrogen alone, in addition to substantial quantities of phosphoric acid and potash. The manurial constituents are moreover present in urine in the form of simple organic compounds which decompose readily when added to the soil and are converted into directly assimilable food for the plant.

Source of valuable manure

The utilization of such a fruitful source of a valuable manure has received little attention at the hands of our agriculturists. The chief reason for this is obviously the difficulty of transport of such a dilute and liquid manure as well as its collection from house to house. Manuring at the rate of 20 lb. of nitrogen per acre would require about 200 gallons or nearly one ton of urine. There is neither any systematic collection of such large quantities of urine under the existing conservancy systems nor would it be practicable to transport such a manure in any appreciable quantities to cultivators' fields, away from habitations. The vast manurial wealth in urine thus goes practically waste except in a few towns where facilities for sewage farms exist and all sullage water is utilized for cultivation.

M. A. IDNANI, B.Sc., Assoc. I.A.R.I., is associated with Agricultural Research Station, Dokri (Sind).

A simple design

The writer has designed a simple urinal which makes the conservation and concentration of urine a highly practical proposition. The manure retains its essential constituents in an available form without any danger of loss on storage. The salient features of this urinal are that urine is absorbed in soil contained in an earthen pot. The soil after saturation is removed and allowed to dry in sun. A part of the nitrogen is converted into ammonia and nitrates which are retained in the body of the soil.

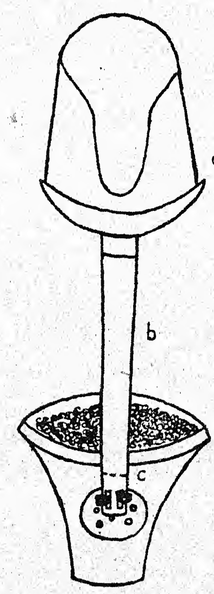


FIG. 1. 'Agri-San' Urinal

The urinal (Fig. 1) consists of three detachable parts a, b and c. The delivery tube of the urinal (Fig. 1,b) has a special attachment (Fig. 1, c) at the bottom which contains a cotton plug inside to ensure an even distribution of urine and prevent the moist soil from choking up the openings. The bottom of the urinal is buried about 6 in. under the soil contained in the earthen pot. Saturation of earth with urine is indicated by moist appearance of soil surface. The soil is then removed and put out in the sun to dry. The earthen pot is refilled with fresh soil and the urinal fitted up for use again.

It was found that the soil in the pot appeared saturated when it had absorbed about 50 per cent of its weight of urine. A concentration of 3 per cent nitrogen could be obtained by using the same soil about six times over, after drying it in the sun each time. In addition, the manure contained 0·7 per cent P_2O_5 and 1·2 per cent K_2O. The major part of the nitrogen, 2·69 per cent, could be extracted with water and would be easily available to the crop. A detailed analysis of the manure ('solurine') thus produced is given in Table II.

TABLE II

Analysis of 'solurine' manure.
(The values are expressed in percentage)

Loss on ignition	Total nitrogen	Water-soluble nitrogen	NH_3 nitrogen	NO_3 nitrogen	P_2O_5	K_2O
7·8	3·0	2·69	55 mg.	28 mg.	0·7	1·2

The simple sanitary urinal designed would, it is hoped, encourage the production of such a promising manure in large quantities for agricultural use. The new manure has been designated as 'solurine' to indicate its source and value.

Scope for the use of the urinal

Conservation of cattle urine constitutes a matter of due attention for every farmer in order to enrich his farmyard manure or compost. For obvious reasons, the collection of this useful manurial fraction is limited to what is voided while the cattle are tethered in their shed. There is an unexploited and a promising source of an equally valuable manure in human urine which naturally lends itself to more efficient collection by an approved system. The huge wealth of manure now going practically waste can be easily preserved and applied to our lands. The utilization of urine as such, without admixture with other wastes, is a proposition which must be considered on its merits, viz. it provides a more quick acting manure than other complex organic manures. The nitrogenous compounds in urine stand almost on par with sulphate of ammonia in their availability, and immediate response of crops may be expected when the 'solurine' manure is applied in an equal dose on nitrogen basis. The manure would be simultaneously supplying fair quantities of phosphoric acid and potash for the needs of the growing crop. At 3 per cent concentration of nitrogen, the quantity of manure required would be only about 700 lb. per acre as compared to 20-40 cartloads (i.e. 20,000-40,000 lb.) of farmyard manure or compost. The average quantity of urine voided by an individual per day is about 1,200 c.c. containing 12 gm. of nitrogen. The annual output of nitrogen works out to about 10 lb. per head which would be sufficient manure for half an acre. On the basis of efficient collection of urine, each population unit of 10,000 could thus be expected to produce sufficient manure for 5,000 acres annually, with practically very little cost and labour.

The 'solurine' manure has the appearance of dry soil and has no offensive smell. The sale of such a manure of quality should present no difficulties and it would provide a source of substantial regular income to the municipalities. The urinal could be easily adapted for public use in towns and villages by providing a suitable-sized drum containing soil for absorption of urine.

Field experiments on the comparative response of crops to applications of this manure are being taken up to assess its value against sulphate of ammonia and the results will be communicated in a subsequent contribution.

In view of the present food shortage in the country, an organized effort for a wide-spread adoption of the urinal and application of the rich and cheap manure produced would be a constructive step of the first magnitude in increasing the yield of food crops.

The design of the urinal is being patented under the name 'Agri-San' urinal. Made of galvanized iron it is a permanent fixture. Further particulars may be obtained from the author.

FEEDING OF RICE STRAW TO CATTLE

WHEAT and rice straws form the staple feed of a majority of the cattle in India. Because of their widescale use, these two straws have drawn early attention of the animal nutrition workers of this country and considerable information has been gathered in regard to their chemical composition and digestibility. These investigations have shown that in chemical make up and in the digestion of major nutrients, such as protein, fat and carbohydrates, the two straws closely resemble each other. In spite of this seemingly similar nutritive character, the cattle in rice and wheat zones markedly differ from each other in their nutritional state. Why the cattle in rice zone are stunted in growth, unthrifty in appearance and poor in production when the availability of major nutrients in rice straw is about the same as in wheat straw remained to be solved.

In early feeding experiments, an interesting clinical symptom of excessive diuresis was noticed in experimental animals fed on rice straw. A few years later, it was shown from a series of investigations carried out in Bengal under the aegis of the Imperial Council of Agricultural Research that cattle kept on a maintenance ration which included rice straw as the roughage, more often than not, showed a larger outgo of calcium than what is received from the feeds. This negative balance indicative of calcium loss from the body was ascribed to large amount of potash present in paddy straw. The excessive diuresis was also thought to be linked with the same factor.

For the first time, by an accurate quantitative estimation the workers of the Animal Nutrition Section of the Imperial Veterinary Research Institute have been able to show the presence of a rather large quantity of oxalates in rice straw. By far the major portion of this oxalate was found to be in combination with potassium and a much lower though significant amount in combination with calcium. Researches carried out on humans and one-stomached animals have shown that certain vegetables, such as spinach, containing oxalates seriously interfere with the assimilation of calcium. The calcium in the preformed calcium oxalate (a salt which is not dissolved by the gastric acid) of the vegetable is almost entirely unavailable. The other oxalate salt which is predominantly soluble, potassium oxalate, interfered in the assimilation of calcium by reacting with this mineral to produce insoluble and unabsorbable calcium oxalate in the gut which is eventually excreted out in the faeces.

Drawing the same analogy for ruminants as observed in one-stomached subjects, it was thought that oxalate in rice straw was the incriminating factor responsible for the poor assimilation of calcium. A detailed investigation was, therefore, undertaken to study the role played by oxalates in rice straw in the assimilation of calcium in cattle. This investigation has now revealed that calcium present as preformed calcium oxalate is unavailable. But this quantity of calcium is relatively insignificant to account for the chronic negative balance under rice straw feeding. Unlike the one-stomached animals, potassium oxalate, before it enters the true stomach of cattle and mobilize calcium of the feeds from the sphere of absorption, is assumed to be decomposed in the fore-stomach into potassium carbonate and bicarbonates. These decomposed products, although they themselves do not directly act deleteriously in the assimilation of calcium, cause severe alkaline symptoms or alkalosis. The alkalosis thus produced either inhibits the flow of gastric acid or neutralizes its effective acidity as a result of which the solubility of calcium in the feeds preparatory to its absorption is adversely affected. Much of the calcium, therefore, passes out in the faeces unabsorbed, and the animals run in deficit calcium balance.

While the above investigation was in progress, another parallel investigation was taken up at Izatnagar to study the effect of soaking paddy straw for 24 hours in a dilute caustic soda solution (about 1 per cent) and subsequent

washing, on its nutritive value. The results showed that this alkali treatment increased the digestibility of carbohydrate moiety in rice straw from 57 to 76 in consequence of which its nutritive value, as indicated by its total digestible nutrients, was increased from 43 to 62.

The alkali treatment of the straw brought about two additional significant results. It effected almost 90 per cent removal of deleterious potassium oxalate and thereby significantly improved the assimilation of calcium from a ration which included alkali-treated rice straw as the roughage. The enhanced availability of carbohydrates from the treated straw was responsible for the other beneficial result, in as much as 25 per cent saving in protein feeding was possible by the protein-sparing action of the carbohydrates. These results prompted the Imperial Council of Agricultural Research to undertake field experiments to explore the possibility of large-scale use of alkali-treated paddy straw under the feeding conditions actually practised by the private stockowners of this country. This investigation is now in progress for sometime past and already certain evidences of far-reaching importance have been gathered. Thus it has been found from the information gathered so far that young stock between 7 and 15 months of age maintained on a diet of rice straw and a limited allowance of concentrate grew at an accelerated rate of 67 to 74 per cent, when the straw was fed after alkali treatment. As a result of the accelerated growth, for 100 lb. gain in weight, in one centre where the animals in untreated straw-fed (control) group took 208 days, those in treated straw-fed (experimental) group had taken only 125 days. Similarly in another centre, where the animals in control group took 435 days, the experimental group had taken 250 days only. After reckoning all necessary expenditure involved in the alkali treatment of rice straw, it has been found that treated straw feeding to young stock is economical, primarily because of the accelerated rate of growth. The experimental group of animals, moreover, looked more healthy and this, together with the fact that they would naturally enter into productive life earlier, add additional economic influence in the use of alkali-treated straw.

Although, alkali treatment of the staple dry fodders of India hold a greater promise, it is yet doubtful how easily the general run of stockowners would take it. The cost of treatment, the lack of mental equipment of the village stockowners to foresee the benefit derived in the long run and the inherent organizational defect in using the method individually are bound to stand in the way of its general adoption. The success of the findings in a practical way thus will have to wait until some form of state organization of large-scale treatment could be ushered in.

The realization of the possible difficulty in the immediate general adoption of alkali-treatment method suggested exploration of a simple processing of paddy straw which would remove the deleterious factor. In the course of their investigation on oxalates in rice straw it was discovered by Izatnagar workers that simple soaking and washing in water removes considerable portion of potassium oxalate. The water-washed straw when fed to cattle was found to cause no diuresis nor any symptoms of alkalosis. Of late a detailed laboratory experiment has been completed which shows that water-washed straw is relatively more palatable. Because of its higher consumption the digestibility of its total carbohydrate is slightly depressed but this depression does not materially affect the value of total digestible nutrients. The elimination of alkalosis improves calcium assimilation to the extent that its almost chronic negative balance in rice straw-feeding is fully overcome if the straw is not very poorly provided with this nutrient. The disappearance of alkalosis is also perhaps responsible in augmenting the utilization of absorbed protein from 27 to 40 per cent. It can, therefore, be concluded that water-washing, although it does not produce the spectacular results of alkali treatment, its use nevertheless brings rice straw at par with wheat straw, in so far as the exertion of sum total nutritive effect is concerned.—(I.V.R.I.)

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. What are the main types of wool recognized in world trade ?

A. The commercial utility of any wool depends upon the intrinsic qualities of the fibre, judged mainly from its length and fineness. These and other allied factors, e.g. freedom from kemp, vary considerably with the breed of sheep, climate and pasturage on which the stock is maintained. The management of the sheep and the preparation and handling of wool before it reaches the manufacturer also considerably affect its quality.

Although there may be over 200 different breeds of sheep in the world, broadly speaking, their wool is classified in the trade under four main types only, viz. (a) Merino, (b) British, (c) Crossbred and (d) Carpet wools. There are a number of qualitative sub-divisions under each type but the above main classification at once indicates the general quality or utility of wool.

(a) *Merino type:* The Merino, which represents the finest quality wool put on the market, is produced by the breed of sheep known by that name. The original home of the Merino is Spain but due to its excellent wool-yielding qualities the breed is now established in several principal wool-growing countries of the world. Owing, however, to changes in climate, soil and management, each country has developed its own type to suit local conditions. The principal Merino types today are the Spanish, Rambouillet or French, Saxony, Silesian, Australian, American, South American and Cape or South African. The Merino wool is noted for softness, fineness, strength and elasticity, and is universally in demand for its superior drawing, spinning and felting properties. For preparing superior grade fabrics Merino wools are an absolute necessity. Only about 40 per cent of the world production of wool consists of this type.

(b) *British type:* The British type of wool is coarser than the Merino and is obtained from about 40 distinct breeds of sheep in Great Britain, belonging chiefly to the mutton class. Although the quality and yield of wool have been only secondary considerations in the development of the British mutton sheep, some of the breeds like Lincoln, Cotswold, Leicester, Romney-marsh, etc. produce very long-staple wools measuring from 8 to 15 inches in length. These are known as 'long wools' in the trade. 'Medium wools', about 3 in. to 8 in. long, are produced by some of the other breeds, e.g. Cheviot, Oxford, Hampshire, Dorset-horn, etc. The British type of wool is grown mainly in the United Kingdom and its annual production is only about 100 million lb.

(c) *Crossbred type:* As the name suggests, this type of wool is of sheep which are raised by crossing one type with another. The need for raising the crossbred sheep arose on account of several reasons. In the first place, breeds which produced for many generations superior quality and heavy weight fleeces developed small carcases and yielded poor quality meat. Secondly, the increased demand for better quality mutton could not be met from sheep bred exclusively for wool. Thirdly, lack of sufficient profit in raising sheep only for wool also necessitated the evolving of a dual purpose sheep, by crossing the wool type (Merino) with the mutton type (British breeds).

Different breeds of British sheep have been selected in different parts of the world for crossing with the Merino. The usual method is to breed 'long wool' British rams with Merino ewes. The crossbred type of wool is coarser than the Merino, but has a longer staple. Compared with pure British type of wool, it has a finer fibre and softer feel. The crossbred sheep thus gives good return both in wool and mutton and is naturally becoming popular amongst farmers who have specialized in mixed farming. At present, nearly half of the wool produced in the world is of the crossbred type. Countries which have a large

number of crossbred sheep, e.g. New Zealand and Argentina, have built up, besides the wool industry, an important export trade in mutton, skins and other sheep products.

(d) *Carpet type:* Wool from unimproved sheep which yield light weight fleeces of uneven, coarse and kempy nature is classified in the world trade as 'carpet wool'. The wool produced in Asiatic countries (including India), falls mainly under the carpet type. In the world trade Indian wool is described as 'East India Carpet Wool'. Skirtings, britch and badly cotted fleeces from the crossbred sheep are also included under this type.

This wool is no doubt inferior to the types described above but the nomenclature should not be taken to mean that the stuff is fit for making only 'carpets' or floor coverings. Some of the better grades of this type can be used for making medium grade serges, overcoat cloth, tweeds, rugs, meltons, hosiery and other fabrics. It can also be used for mixing with finer wools for giving the necessary 'substance to the fabric'.

A small quantity of 'skin or pulled' wool from the tanneries also enters the world trade. It is called 'tannery wool'. But there are no distinct classifications for this wool and it is usually marketed under one of the lower grades in each of the above-described types.—Reproduced from the *Handbook on the Quality of Indian Wool*.

KARAKUL SHEEP FOR NORTH AUSTRALIA

A BUSINESS syndicate proposes to develop the karakul sheep industry in the Northern Territory of Australia. The Federal Minister for the Interior, Mr Johnson, has assured syndicate representatives that he will give all possible help.

Karakul sheep, bred in South Africa, France, and Persia, give one of the most valuable furs in the world, known in India as Persian lamb's wool.—*Australian Agricultural Newsletter*, Release No. AGN/137.

What's doing in All-India

BENGAL

M. Abed

THE food problem of Bengal remaining acute, great emphasis was laid on the drive for increased food production and this is being continued with greater intensity than in the preceding years. With a view to achieve this end, about 27 lakh acres of land were released from jute by regulating the area under that crop and steps were taken to cover the land mainly by paddy, the staple crop of Bengal.

Distribution of improved seeds

Altogether 1,77,200 md. of paddy seeds, 65,554 md. of *rabi* seeds, 19,744 md. of famine crop seeds and 151 md. of fodder seeds were distributed among the cultivators during the year 1945-46. The fodder seeds consist of 35 md. of maize and 116 md. of cowpea seeds. The 19,744 md. of famine crop seeds consisted of the following:

Kalai	18,529 maunds
Barley	1,010 ,,
Groundnut	42 ,,
Castor seed	163 ,,
	19,744 maunds

The seeds were distributed either for cash or loan on *sowai* basis at the option of the cultivators. The Government of India granted an interest-free loan of Rs. 36,83,000 for purchase and distribution of seeds and agreed to bear 25 per cent of the actual loss or up to Re. 1 per maund whichever was less. The Government of Bengal, however, requested the Government of India to grant a subsidy at a flat rate of Re. 1-8 per maund.

The targets for the *aus* and *aman* paddy were made double those of previous years and roughly 50,000 acres were covered by *aus* and 1,63,000 acres by *aman* paddy from the distribution of these seeds. Taking one maund of improved *aus* seed to give an additional yield of six maunds, altogether there was an additional yield of 1,62,996 md. of *aus* and 7,34,802 md. of *aman* paddy. An area of 38,500 acres was covered by wheat by distribution of 28,939 md. of wheat seeds. Thirty-six tons of *bajra*, 83 tons of maize and 74 tons of *jowar* were brought from the Punjab and United Provinces in June, 1946 for distribution among the cultivators for growing fodder.

The Government of Bengal have already taken up a scheme for the establishment of 28 seed multiplication farms in the province. Each district will have a 200-acre seed farm which will be chiefly devoted to the production of improved seeds of paddy and other food grains and will arrange the distribution of improved guaranteed seeds through Government seed stores.

Under the Cold Weather Vegetable Scheme roughly 3,90,79,000 seedlings were raised in 178 seedling stations of which 1,76,75,000 seedlings were sold. Altogether 6,990 lb. of seeds were sold in small packets. It is estimated that 4,000 acres were covered by the cold weather vegetables. Besides, 10,114 quarter ounce packets of Indian summer vegetable seeds were distributed at cost price and about 5,700 lb. of vegetable seeds were distributed free of cost.

Fertilizers

A total quantity of 3,00,221 md. of fertilizer was distributed against the target of 4,00,000 md. The stuff being received during the latter part of 1945-46, the whole stock could not be put out. The demand for bonemeal was less insistent than that for oilcake. Altogether 990 tons of bonemeal were distributed. As for sulphate of ammonia, a target of 10,000 tons was fixed for the year 1945-46, 5,000 tons to be sold at 50 per cent subsidy for application to paddy and wheat and the other 5,000 tons to be sold at cost price to intending purchasers.

M. ABED is the Personal Assistant to the Director of Agriculture, Bengal, Calcutta.

But practically 5,190 tons of sulphate of ammonia was sold at subsidized rate and 995 tons without subsidy. The latter was applied to sugarcane, potatoes and vegetables.

Sugarcane

With a view to replace Co213 which is red-rot ridden as well as other low-yielding varieties a scheme for distribution of improved varieties of sugarcane cuttings was undertaken and 19,540 md. of improved varieties of seeds were distributed during the year 1945-46.

In the current year 1,10,000 md. of sugarcane seeds will be distributed under the Sugarcane Development Scheme on a subsidy of 4 as. per maund to the growers and the Government will bear 4 as. per maund as incidental charges. The net loss to the Government on this account would be Rs. 56,000. Under the Sugarcane Seed Distribution Scheme 70,000 md. will be sold to growers on a subsidy of 20 per cent and 1,000 md. of new varieties, viz. Cos 146,186,453 and 395 will be imported from Bihar and the United Provinces. The latter will be purely under experiment at the leading factory farms.

Potatoes

Despite difficulties of transport and procurement about 15,000 md. of seed potatoes were imported from the Punjab, Bihar and Assam and distributed at controlled rates during 1945-46. A scheme for growing comparatively disease-free seed potatoes has been undertaken. Under this scheme an area of 100 acres has been sown in Darjeeling. The harvest of this crop will be planted in the plains in October, 1946 and harvested in March-April, 1947.

A scheme for production and marketing of vegetables for supply to the civil population of Calcutta was undertaken. Under this scheme about 12,000 md. of vegetables were produced by the growers and sold in the Calcutta markets at controlled prices under Government supervision.

Although some losses were incurred by the Government on this account, it served as an incentive for extension of vegetable cultivation in the province.

MADRAS

V. VENKATARAMAN

THE recent world war has brought the problem of improving the livestock of the country to the fore-front and the Government are anxiously alive to the situation. The big post-war reconstruction schemes involving huge outlay and covering all aspects of animal and dairy husbandry including control, prevention and treatment of cattle disease have been proposed. Large number of cattle shows, which act as an aid to the progress of the breeding industry and the improvement of livestock have been organized throughout the province under the auspices of the Veterinary Department. Therefore, it is up to those interested in the welfare of livestock, to those who are trying to grade up their cattle to a particular strain, to those that take to the animal breeding industry and to the agriculturists who cannot do without bullocks, to rise to the occasion and take full advantage of the improved facilities offered. How do the cattle shows benefit the ryots? What is all that the ryot sees, hears and learns in a show? He sees splendid specimens of heifers and bulls, cows and bullocks turned out as winning exhibits. His sense of confident satisfaction at the condition of his exhibits gets shaken when he compares it with that of his more enterprising neighbour. He is tempted to ask his friend at the show what he has been doing to his animals that they look so fit. By testing others he improves his ideas of cattle management. He listens to learned discourses by the experts on genetics, nutrition, milk and a host of other important subjects. Thus, the show visitor and the show participator in course of time become show-minded.

One-day cattle shows are now in vogue in many districts, notably in the home of the Kangayam, the Ongole and the Umbalachery. These shows are progressively increasing in number in each district and the more the num-

V. VENKATARAMAN, G.M.V.C., is the District Veterinary Officer, Salem.

ber of shows, the more people that will benefit by it. They apply the knowledge gained and bestow greater attention on the maintenance and upkeep of their cattle thus unconsciously acquiring the technique of preparing animals for a show—an art by itself.

In Salem district, three shows were held during the year. The Mecheri show topped the list in the number of exhibits and award of prizes and this was greatly due to the effort of Sri Nachiappa Gounder, President, District Board, Salem, who contributed a large number of prizes, and the presence of the Pattagar of Paliacottah, the foremost breeder of South India, added not a little to the importance and purpose of the show. One noteworthy feature of this show was the presence of a large number of Mandia rams and their progeny as exhibits. This ring attracted a large crowd of spectators and their appreciation of the improvement noticed in the progeny was noteworthy.

A scheme for the improvement of the mutton type of sheep of Mecheri in Omalur taluk in Salem district was introduced in August, 1944. One hundred Mandia rams were distributed in 42 villages of Omalur taluk round about Mecheri. During the period from August, 1944 to May, 1946, it is estimated that about 1,500 lambs were born to these Mandia rams.

The shows at Anchetty and Hosur also attracted a large number of exhibits and visitors. At Anchetty, the President and members of the Cattle Breeding and Marketing Cooperative Society evinced great interest. This Society has been functioning for the past nine years, for improving the methods of cattle breeding (Hallikar breed) and for arranging for the joint purchase and sale of cattle, required or possessed by the members. It has, on its role, about 300 members. In addition to the prizes awarded by the Civil Veterinary Department, Madras, the Society contributed Rs. 30 towards prizes for the best bulls maintained by the members of the Society.

SIND

L. M. Hira

THE research work on the evolution of improved varieties of crops, determination of simple and practical method of reclaiming *kalar* (saline) lands and maintaining soil fertility, water requirements of crops, determination of most suitable cultural practice of various crops, investigation of causes and control of various plant diseases, etc. continued to be done at both the Agricultural Research Stations, Sakrand and Dokri.

The Propaganda Section carried on the work of introduction of improved varieties of crops, distribution of improved seeds and agricultural implements and organization of demonstration plots on the zemindari lands with a view to bring home to the cultivators the advantages accruing from the adoption of modern methods of agriculture.

Use of fertilizers

With a view to popularize the use of fertilizers, about 800 tons of sulphate of ammonia were sold to the growers for application on paddy, wheat, fruits and vegetables at a concessional rate of Rs. 6-4 per maund. In order to provide further incentive, as also to obtain increased crop yields, the Government have recently sanctioned the selling of this stuff at a nominal rate of Re. 1 per maund or Rs. 1-4 a bag of 100 lb. It is expected that as a result of this concession, increased area will be put under rice, wheat, etc. and much better yield will be obtained from these crops.

A Rice Seedling Scheme has also been sanctioned for Karachi district in order to bring in more area under paddy cultivation in this district. Under the Scheme, seedlings are raised on pump water from a *chach* and supplied to growers at the moderate rate of Rs. 10 per bundle sufficient to transplant one acre of the land.

Seed distribution

Arrangements were made to buy about 20,000 maunds of seed potatoes from Nilgris, Quetta, Patna, etc. for distribution amongst the potato growers throughout the province. About 15,000 to 20,000 lb. of vegetable seeds were supplied to the vegetable growers. Similarly arrangements were also made to

L. M. HIRA is Marketing Officer in Sind.

purchase 30,000 maunds of wheat seed from the Punjab for distribution in the province.

Compost making

Special staff was engaged in the manufacture of compost manure from town wastes. Roughly about 2,82,000 c.ft. of manure were manufactured and out of this some 1,14,120 c.ft. were sold at the subsidy rate of as. 12 per 50 c.ft. given by the Government of India. This work, however, has been now temporarily suspended due to some technical defects in the method of manufacture, which is being investigated.

Supply of implements, fuel oil, etc.

Since the agriculturists and growers were experiencing lot of difficulty in securing various agricultural implements for their use, arrangements were made by the Department of Agriculture to secure iron and steel material for issue to the blacksmiths for fabrication into agricultural implements. About 700 tons of raw material were distributed and 6,000 to 7,000 iron implements of different kinds were manufactured and made available to the agriculturists. Similarly the Department continued to help the cultivators in getting the supplies of diesel oil, petrol, kerosene oil, rubber cart tyres, etc. required for agricultural purposes.

Tractor ploughing

The Department possesses at present only four tractors. Some 4,000 acres were tractor-ploughed. As there is great demand for tractor ploughing in the province, the Department has decided to purchase another 30 tractors and indents for the same have been duly registered with the Government of India. The rate for tractor ploughing has been, however, increased from Rs. 8 to Rs. 12-8 in view of the higher prices of raw material as well as higher wages to be paid to mechanics.

Fodder shops

As the cattle owners in the Karachi suburban area were experiencing great difficulty in getting concentrates, fodders, etc. for their milch and other cattle, the Government sanctioned a special scheme for supply of cattle feeds to them. The Marketting Officer in Sind has been put in charge of the scheme and so far 20 fodder shops have been opened for the convenience of the maldars.

ASSAM

N. K. Das

THE 'grow more food' campaign specially undertaken to meet the requirements of the situation arising out of the war will terminate on 31 March, 1947. In fact, it will then merge into post-war development schemes. So far as the Department of Agriculture is concerned, the present campaign has served as a preparation for putting the future programme into operation. Almost all the 'grow more food' activities, it is expected, will continue as a part of the post-war developmental work now being envisaged and in the additional personnel now being entertained, the Department will find a large part of the machinery that will be required to give effect to the post-war schemes. It has now four new sections added to it, viz. (1) Irrigation (small projects), (2) Horticultural Development, (3) Poultry Development and (4) Dairy Development. The general Agricultural Section has been strengthened by the addition of nine District Agricultural Officers (Assam Agricultural Service, Class II), ten Agricultural Inspectors, four Assistant Agricultural Inspectors and 145 Kamdars. The permanent staff of the Department has also been strengthened by making a few new appointments.

The activities of the Irrigation (small projects) Section started in 1942-43, and as a result of the small projects (bunds, drainage, irrigation channels, sluice gates, etc.) executed by it, a substantial increase in the provincial production of rice has been achieved. The figures showin in Table I will speak for themselves:

N. K. DAS, L. AG. (HONS.), is Assistant to the Director of Agriculture, Assam.

TABLE I

Irrigation results for the years 1942-43 to 1945-46

Year	No. of projects completed	Cost to Government		Area affected		Increased yield obtained in terms of paddy or rice by the year's work
		Staff (Approximately)	Contribution at 50:50 with cultivators	New area opened out during year (At 30 md. paddy per acre increased yield)	Existing area benefited (At 3 md. paddy per acre increased yield)	
1942–43	101	(Done by Agricultural Staff)	Rs. 38,296	16,192 acres	1,45,728 acres	34.183 tons paddy or 22,630 tons rice
1943–44	288	Rs. 40,970	Rs. 1,38,503	15,720 acres	1,41,480 acres	33,186 tons paddy or 20,725 tons rice
1944–45	156	Rs. 68,206	Rs. 1,24,596	11,434 acres	1,02,905 acres	27,842 tons paddy or 17,400 tons rice
1945–46	506	Rs. 1,60,356	Rs. 3,30,150	20,660 acres	1,85,943 acres	43,615 tons paddy or 27,259 tons rice
Total	1,051	Rs. 2,69,532	Rs. 6,31,545	64,006 acres	5,76,056 acres	

Progressive effect on annual production in 1946 in terms of cleaned rice in tons	1945–46	1944–45 less 20 per cent	1943–44 less 40 per cent	1942–43 less 60 per cent	Total
	27,259 +	13,920 +	12,435 +	9,052 =	62,666 tons

Considerable progress in the direction of increasing the production of *boro* (spring rice) under power pump irrigation is also being envisaged. The Department has placed orders for 28 diesel oil engines and necessary pumps for this purpose. Some of these are being received now. The Power Pump Irrigation Section has been in existence since pre-war days.

With a view to putting on a sound basis all the engineering work now being done by the Department, and also for the purpose of devising and introducing improved agricultural implements and machinery suited to Assam conditions, the Government of Assam decided to appoint a duly qualified Agricultural Engineer with the ultimate purpose of having a full-fledged Agricultural Engineering Section in the Department of Agriculture. Unfortunately no qualified candidate could be found. It is likely that the services of an Engineer of the Public Works Department will be borrowed for the time being.

The Horticultural Development Section which came into existence in December 1945 is expected to meet a long felt want. Assam is an important fruit-growing province but the cultivation is based more or less on primitive methods. This new section is intended to introduce improvements and it will also run six departmental nurseries.

The Poultry Development Section also started in December 1945. It will run three departmental poultry breeding centres and take other steps to encourage and help the breeding of improved types of birds by private individuals. The Section is under a Poultry Development Officer.

The Dairy Development Section came into existence only towards the end of April last, with the appointment of a Dairy Development Officer. Prior to this a survey of the present position in regard to production and available supply of milk around urban areas had been instituted with effect from January, 1946. The special temporary staff engaged for the purpose still continues its work. The main activities of the Dairy Development Section will be directed towards organizing supplies of good milk for urban areas and subsidizing the production of milk by issuing oilcake and salt at concessional rates for the feeding of cows.

The Department of Agriculture has already under way a departmental scheme for the multiplication of seeds of improved varieties of paddy for issue to cultivators. But till recently the position in the Assam Valley in regard to the production of seeds of improved varieties of *aus* or *ahu* (autumn) paddy was not satisfactory. Primary *ahu* seeds are now being produced for the Assam Valley under a scheme sanctioned in connection with the 'grow more food' campaign.

In view of post-war agricultural development the stocks of cattle in the departmental farms have already been considerably augmented. The question of the rehabilitation of the cattle population of Assam is also engaging the attention of the Department.

Three vocational schools for the training of lower grade subordinates have been sanctioned. These are expected to continue as one of the post-war schemes. A number of other schemes are now under the consideration of the Provincial Government.

The Citrus Fruit Research Scheme jointly financed by the Provincial Government and the Imperial Council of Agricultural Research is expected to continue for another five years, that is up to March, 1951. The present sanction for the Cattle Nutrition Scheme extends up to March, 1949. There are now several other special schemes under the consideration of the Government, namely a Research Scheme for Cotton, a Scheme for Developmental Work in Sugarcane, a Scheme for Research Work in Sugarcane (the term of the previous Sugarcane Research Scheme expired on 31 March 1944) and a Scheme for Investigation of Grazing Problems with a view to find out a cheap system of maintaining village cattle by rotational grazing. If and when sanctioned, these are expected to be financed jointly by the Provincial Government and the Imperial Council of Agricultural Research or the All-India Commodity Committees concerned. An enlarged Jute Staff Scheme and a Coconut Nursery Scheme which are now engaging the attention of the Department of Agriculture are also expected to be financed partly by the Commodity Committees concerned if and when they materialize. A Scheme for the Improvement of Pulses to be financed jointly by the Provincial Government and the Imperial Council of Agricultural Research has been sanctioned. The work is expected to start very soon.

The Marketing Section has been running on a temporary basis for the last 11 years. Nothing has been decided as yet as to whether it should be made permanent.

A special Deputy Director of Agriculture appointed with effect from the middle of January last carried out a survey of culturable waste land in non-cadastral areas in the districts of Kamrup and Darrang. It is hoped that this will be followed up with a policy of bringing suitable waste land into cultivation.

The question of producing exportable surpluses of rice for the deficit provinces of India received consideration of the Government and the Department. It was considered that the most expeditious way of achieving tangible results would be to increase the production of *aus* or *ahu* (autumn) paddy. But at the same time it was realized that a stage had been reached where it was extremely difficult to achieve the desired objective unless a satisfactory minimum price was guaranteed to the producer for any quantity of the produce that he might offer for sale. From a communique of the Government of Assam issued on 30 April it appears that minimum prices for all classes of paddy are going to be fixed, but it is not yet clear whether the Government would be prepared to buy any quantity that cultivators cannot dispose of at those minimum prices and offer to the Government for sale.

An Agricultural Officer was appointed by the Government of India, in March last, to be in charge of agricultural development work in the hill tracts of Assam. It is hoped that the agricultural problems peculiar to these tracts will now receive greater attention and be more effectively tackled than hitherto.

Across the Borders

DEVELOPMENTS IN ARTIFICIAL INSEMINATION

By JOSEPH EDWARDS

WHEN, before the war, the British farmer read that in Soviet Russia up to 2,000,000 cows were being inseminated each year, he felt that the process was very remote and that conditions in Russia were probably very different from those in this country. But in the last few years artificial insemination has come to be applied on an appreciable scale in England and Wales, and it may soon be a matter of surprise that no appreciable developments have taken place in Scotland.

Things have altered considerably since the practical application of the technique of artificial insemination and its exploitation throughout the U.S.S.R. In 1936 the first commercial centre for the artificial insemination of dairy cattle was started in Denmark, and in 1945 more than 400,000 cows (30 per cent of the dairy cattle population of Denmark) were artificially inseminated. A start was made in the United States in 1937, and in 1945 a very similar number of cows (though representing a much smaller proportion of the total dairy cattle population) were got in calf by artificial insemination.

It is often stated that the technique is one which is chiefly of interest to the farmer with a small number of cows, and from this it has been argued that the lack of development in Scotland may be due to the fact that Scottish herds tend to be fairly large. Statistics show, however, that there are areas in Scotland where the average size of herd is very similar to the Danish average, and also to areas in England where artificial insemination is practised. With the present rather inflated prices of bulls, it is difficult to say how big a herd must be to justify keeping a bull. The main argument in the United States for the use of artificial insemination in herds of up to 20 to 30 cows is that, by cutting out the cost of feeding and maintaining a bull, and keeping in its place an extra cow, the profit on the milk from the extra cow will pay for the insemination fees for the whole herd. Recently there was an announcement in the English farming press that a very large farmer in Hampshire had entered all his herds, totalling 1,000 cows, for insemination by the Hampshire Cattle Breeders' Society. This Society charges £ 2 per cow, and at first sight an annual insemination bill of £ 2,000 may seem excessive, but to get this number of cows in calf (in the herds in which they are grouped) by normal mating, it would be necessary to keep about 30 bulls, and the annual depreciation and the capital investment in such a number, at the present prices, would be at least as much as the annual insemination fees. For £ 2,000 the owner is able to get his cows in calf to much better bulls than he could afford to buy.

One also hears the argument that in Scotland dairy farmers take much more interest in the selection of their herd sires than do their brothers south of the Border. There may be some truth in this, and I have heard one Scottish farmer say that if one took away the thrill and excitement he has in the careful selection of his next herd sire, one might as well take away his herd; he does not object to mass livestock improvement for the commercial man, but he insists on directing his own breeding programme himself. Against this must be set the fact that no group of dairy cattle breeders is more pedigree conscious than the Danish dairy farmers. They have been milk recording and progeny testing for longer than any other dairying community in the world, and if more than 30 per cent of them have been

JOSEPH EDWARDS is the Head of the Department of Dairy Husbandry, Milk Marketing Board, England.

able to agree on a cooperative breeding programme it is only reasonable to think that there must be something in it. There is also the fact that a considerable number of pedigree breeders in the United States make use of artificial insemination centres, normally entering a selected group of their cows for insemination by the bulls belonging to the society of which they are members. There is one society in Illinois where 75 per cent of the cattle inseminated are pedigree animals, and the members of the society are following a breeding programme as constructive and well-thought out as any that can be worked in a private herd.

It has also been said that the value of artificial insemination may not be as great in Scotland because there is greater freedom from disease there than in England. But, with reference to this point, it must be made quite clear that artificial insemination is not a cure-all for cattle diseases. In any case, even if the position is better north of the Border, it is no better than in the United States or Denmark.

A special and rather novel approach to artificial insemination is about to be made in New Zealand by the New Zealand Dairy Board. In that country the analysis of milk records over a period of years has shown that the level of improvement of commercial herds by the use of young pedigree bulls selected in the usual way has just about reached the limit, i.e. they have been graded up in terms of production to the level of the pedigree herds themselves. In searching around for means by which a further hereditary improvement in production may be effected, the dairy breeding authorities in New Zealand have come to the conclusion that it can be brought about only through the extended use of progeny-tested sires of high merit. It is therefore proposed to select a few of the very best sires on progeny test and to use them at artificial insemination centres for selected pedigree bull breeding herds so that a large supply of the sons of these outstanding bulls can be made available for use in the commercial herds.

Wartime developments in England and Wales

As a result of research and development work carried out at Cambridge, a scheme for the practical application of artificial insemination was submitted to the Agricultural Improvement Council early in 1942. It was decided to start two pilot centres (at Cambridge and Reading) to test out practical possibilities under commercial conditions. This decision fitted in well with the livestock policy of the Ministry of Agriculture and Fisheries announced about the same time. For example, soon after the start of the Cambridge centre, the Cambridge War Agricultural Executive Committee had to carry out an inspection of all herds in the country with a view to discussing breeding policy on the farm. The average size of herd in Cambridgeshire is nine cows, and in a great many cases it was found that the bulls in these herds were of very inferior quality. It was easy to persuade the farmers concerned to get rid of these bulls when it was possible to put them in touch with the Cambridge Artificial Insemination Society, from which the services of first class bulls were obtainable.

The success of the pilot schemes led to a special committee being appointed by the Ministry of Agriculture to consider further development on a national scale. It was agreed in principle that the movement was one which should be developed in the interests of the producer and that the cooperative system of organization was one to be encouraged. At this stage the Milk Marketing Board (which had earlier taken over the National Milk Recording movement) came forward with a plan for the development of artificial insemination under its aegis, and it was agreed that, although the Board would not be given a monopoly of the development, it should shoulder a major part of it. A National Advisory Committee on Artificial Insemination was then formed, on which the breed societies, the National Farmers' Union, veterinarians, and agricultural scientists came to be represented. This Committee receives requests from various parts of the country for an artificial insemination service and is responsible for the location of centres (chiefly in relation to the density of the cow population, and, to some extent, in relation to disease problems). It also interests itself in the breeding policy to be followed at each centre and the general efficiency with which the service is carried out. In the early stages it was agreed that a financial guarantee against loss would be made by the Treasury, and this guarantee [covered by the Agriculture (Artificial Insemination) Act, 1946] is available over a period of five years (1945-50).

The present position in England and Wales

is as follows: The Board has four centres in operation; in Suffolk, Buckinghamshire, Shropshire and Durham. The first-named centre was founded in 1943 as a local coöperative society by a group of farmers in North Suffolk and was taken over by the Board in November 1944. The increasing popularity of the service is shown by the fact that the numbers of cows inseminated increased from 1,057 in January-March 1945 to 1,857 in January-March 1946. The centre in Buckinghamshire was started as a commercial venture by a private breeder and was taken over by the Board in June 1945. The centres in Shropshire and Durham only began operations in January and February, 1946. The Milk Marketing Board's present building programme includes the erection of centres in the near future in Carmarthenshire, Dorset, Montgomeryshire, Cornwall, Devon, Gloucestershire, Cheshire and Lancashire, and provides somewhat later for additional centres in Staffordshire, Wiltshire, Yorkshire, Kent, Cumberland, Essex, Derbyshire and Caernarvonshire.

An artificial insemination service from centres not operated by the Milk Marketing Board is given in the following counties: Cambridgeshire and Hampshire (farmers' cooperative societies); Somerset, Worcestershire and South Devon (private enterprise); Berkshire and Denbighshire (Ministry of Agriculture).

The Ministry of Agriculture is also about to operate two 'disease control' centres in Cardiganshire and the Nevin peninsula of Caernarvonshire. It is well known that artificial insemination has been shown to be an effective means of combating the venereal disease caused by the *trichomonas* organism. This disease is spread by the bull, and the Ministry is adopting artificial insemination as a control measure in the two counties mentioned in areas where premium bulls are normally much used, but have had to be given up because of the disease. The Denbighshire centre was started for the purpose of controlling trichomoniasis and has done so successfully.

The financial success of a centre is expected to depend to a large extent on the density of cows in the area in which it operates, and it will be seen from the following figures that there are wide differences in this respect among the areas developed, or about to be developed, in England and Wales. The numbers of cows are those within a ten-mile radius of the centre.

County		Number of cows
Cambridgeshire ..	.. approx.	6,000
Caernarvonshire	.. ,,	11,000
Durham ..	.. ,,	14,000
Gloucestershire ..	.. ,,	20,000
Dorset ..	.. ,,	34,000
Staffordshire ..	.. ,,	49,000
Cheshire ..	.. ,,	60,000

Two large items in costs are the salaries of inseminators and car transport, and it is obvious that there are considerable economies possible in these items of cost when the cow population is well concentrated. In spite of this, it has been agreed to give a national service at a uniform fee and the minimum fee agreed upon for the present is 25s. per cow (this includes up to three inseminations, should the first or the first two not prove successful).

The Milk Board's interest in artificial insemination

It has already been noted that in 1943 the Milk Marketing Board took over the milk recording movement. Since then, and in spite of wartime difficulties, the number of cows recorded has increased from 4 per cent to 17 per cent of the total dairy cows in England and Wales. The Board's motive in taking over the movement was to provide a basis for increased efficiency in milk production on the farm. The motive in sponsoring the development of a large part of the artificial insemination service is the same, for the Board believes that only through artificial insemination can the average milk producer in the country improve his stock through the medium of really good bulls.

At the head office of the Milk Marketing Board, and within the Department of Dairy Husbandry, work on National Milk Records and on Artificial Insemination are being closely linked, and, with the recently announced creation of the Bureau of Records, through which the progeny testing of pedigree bulls and life-time records of production for females will be organized, the integration will be even closer. The two movements will also come closer together in the field, and already, in counties where the artificial insemination service is well developed, the local branch dealing with National Milk Records is being brought into the picture in the planning of progeny tests for the bulls being used in the area.

Organizing a new centre

The request for an artificial insemination service in a given county usually comes from the county branch of the National Farmers' Union, acting either on their own or in conjunction with the War Agricultural Executive Committee. If the request is approved by the Central Advisory Committee, the Milk Marketing Board looks round for a suitable site. In the absence of a piece of land with buildings which can be readily adapted, a clean site of eight to ten acres is sought, with the usual services: water, electricity and telephone. The new buildings erected on the site include a block with laboratory and offices, a bull block to house 10-20 bulls, and a pair of cottages to house a stockman and a stockman inseminator. When a start is made on the buildings, the Board calls for the creation of a local advisory committee on the basis laid down in its rules. For the first year this committee consists of three representatives appointed by the county branch of the National Farmers' Union, three from the county War Agricultural Executive Committee, one from the local division of the National Veterinary Medical Association, and two appointed by the Milk Marketing Board. A meeting of this committee is called to decide, on the breeds of bulls which have to be kept to service the centre and to arrange for the publicity and propaganda. In the early stages of organizing a new centre the Milk Marketing Board arranges for the selection and training of the necessary personnel, for the selection and testing of the bulls required, and for the equipment, transport, etc. It is best to allow a new centre to start off quietly, for harm has already been done in this country and abroad by undue boosting of the service before the new organization has had time to settle down.

After a centre has been in operation for three to six months, and when the veterinary manager in charge is satisfied that he is getting good results, field days are organized. The bulls are paraded for inspection and the technique of artificial insemination is demonstrated.

In some counties War Agricultural Executive Committees have given considerable help by carrying out surveys to ascertain the potential demand for a service and to advise a new committee as to the breeds of bull likely to be required. At the end of the first year of operations the six members of the committee who were appointed by the National Farmers' Union and the War Agricultural Executive Committee retire, and from this point these places are filled by annual election from among the members of the Society.

One of the main functions of the management committee is to recommend bulls for purchase to the Milk Marketing Board. At the present time this involves a considerable amount of investigation in order to complete the milk record information which is required in the pedigree. (It is hoped that the new Bureau of Records will in time do away with the need for this spade work). When the committee and the Board are satisfied with the pedigree of a bull, the Ministry of Agriculture is asked to carry out its inspections and tests for an artificial insemination licence. The former covers inspection of the bull himself, his dam, his sire, and as many near relatives as possible. The latter include tests for tuberculosis, contagious abortion, trichomoniasis and fertility, and not until the bull passes these tests can he be purchased.

To date it has not been found possible to keep a bull at a centre for longer than he would normally remain in a herd, i.e. about two and a half years, as at the end of this time his daughters become due for service. A small independent society has to get rid of such a bull, but in the case of the Milk Marketing Board, with its many centres, it is possible to move him to another area where he can continue his good work. It is hoped in all cases to provide committees with a selection of such bulls from which they may make a choice which will suit their local needs.

Another important function of the committee, at a later stage in the centre's development, is to report on the progeny of the bulls. As has been mentioned, National Milk Records is now organized so as to provide milk records for these progeny tests and these, together with committee's reports on type, udder conformation, etc. in the bull's offspring, form a complete picture of the bulls' performances.

Technical considerations

It is too early yet to say what is the ideal size of an artificial insemination centre, especially in relation to the number of bulls which should be kept. In the United States there are centres with as many as 60 bulls, but there they do not have foot-and-mouth disease. An outbreak of this disease affecting a centre

with such a number of high-priced bulls would be a very serious matter, and for this reason it has been decided to limit the number at any one centre to 25-30 bulls. It is not yet obvious how many cows may utlimately be inseminated in a year from one bull. This depends, to a great extent, on the rate of dilution of the semen. At no centre in this country have rates above 1 in 25 had to be used, but there is no doubt that rates of 1 in 50 will give satisfactory results. Even higher rates of dilution are the subject of experiments in the United States. Over the next few years it is safe to estimate that the average number of cows inseminated per bull will be about 1,000 per annum, and at this rate 20 bulls can service 20,000 cows. In the densest areas in England and Wales, quoted above, it is obvious that this number will be required to service the cows likely to be brought into the scheme within the ten mile radius of the centre's operation. In other and less dense areas the numbers will not be adequate, and here it will be necessary to develop sub-centres which keep no bulls, but to which semen is sent daily, or every other day. (Bull semen stored in egg yolk remains fertile for four days and there is no decline in fertility over this period). Sub-centres are already operating very satisfactorily from main centres in Berkshire, Hampshire and Suffolk, and members obtaining insemination service from them are just as satisfied as those that use the main centre.

Centre routine

The veterinary manager at a main centre arranges a schedule of collections from his bulls according to individual performances and according to the quantity of semen required. Collections are normally taken from each bull on every third to fourth day. The semen, after collection, is immediately examined for fertility, and if this is satisfactory, it is then diluted with egg-yolk phosphate dilutor. The semen required for the day's work is distributed among the inseminators and the remainder is stored in the refrigerator for use over succeeding days. Members with cows which require service telephone to the centre before 10 a.m. and the veterinary manager then plans the daily routes for himself and his men. Periodically, throughout the day, inseminators telephone back to the main office for any requests that have come in since their departure, and all such calls, except those received late in the evening for cows which have come on heat in the late afternoon, are dealt with the same day. Very late calls are dealt with early the following morning.

The operation on the farm is very speedy. The farmer quickly learns the kind of cooperation expected of him and is usually available to point out the cow requiring insemination and to give the little help that is required. After insemination a certificate giving the name of the bull used is given to the farmer and the fee of 25s. is collected in cash. It is possible for an inseminator to be on and off the farm in under five minutes.

The care of the bulls at the centre is obviously of first importance, and in this connection it can be said that their health and fertility are better safeguarded than on the average farm. We are far from knowing all that we would like to know about ways of stimulating fertility in the male, but it is found that a good dairy ration containing up to 10 per cent of animal protein (fish meal or skimmed milk powder) gives very good results. The bulls are fed and exercised according to individual requirements.

The veterinary manager is in complete charge of his centre. He carries out his share of routine inseminations and at the same time gives particular attention to herds in his area which are troubled by sterility. He does not, as do the veterinary surgeons engaged in this work in Denmark, give sterility treatments, but he arranges for consultation with the owner's private practitioner and with the Ministry's Sterility Officer, and from the complete breeding records in his office he is often able to give his colleagues valuable advice and case histories. It is felt that, for financial reasons and because of the nature of the work, the straightforward routine inseminations are best carried out by laymen working under the veterinary manager. Such men may be recruited from the ranks of cowmen, and after a month's training it is usually possible to decide whether or not the man will make a good inseminator. The Ministry of Agriculture has agreed to organize a central training scheme for inseminators, and at the end of a month's training in theory and practice the men will be attached to an operating centre at which, for a further five months, the effectiveness of their work is carefully watched. If, at the end of that time, they are regarded as satisfactory, they will then be

licensed as inseminators. The best of these men may be chosen later to take charge of sub-centres, which they may operate either by themselves or with other laymen working under them.

Benefits to the farmer

There is no doubt that artificial insemination has proved itself in England and Wales and that it will receive increasing support from the dairy-farming community. The chief brakes on progress at present are the difficulties of building, securing the right type of bulls, and obtaining equipment and trained personnel.

Dairy farmers in England and Wales, largely as a result of the Ministry of Agriculture's publicity and advisory work, are paying far more attention to livestock improvement than they have ever done. Many of them realize for the first time that they have a chance to get into the pedigree business, and they mean to make the most of it. For many of them it is a short step from joining an artificial insemination centre to applying to a breed society for entry on its grading up register. The long term improvement in the capital value of their herds appeals to them, and this is shown, even in the early stages, by the fact that many who in the past have never reared their calves, now refuse to part with them, even when very attractive offers are made. It is clear that, in this field, there is a greater chance for educational work than has ever before been presented in the field of animal husbandry, for a farmer who has some reason to take pride in his stock is much more likely to seek advice on good calf management, young stock management, and ultimately in feeding for milk production, than one who, often through force of circumstances, has been using a very inferior sire.

The more immediate advantage—that the farmer with a herd of average size can get his cows in calf to a first class bull for less than it would cost him to feed an inferior one—is quickly appreciated. The sheer convenience of the service also has an appeal. There is the member who says that he will never keep another bull because of the ever-recurring cost of mending his bull-pen, and the desire to dispense with the element of danger attached to handling a bull on a small farm is also given as a reason for adopting artificial insemination. One hears little to-day of the early fears held by some for the health and vigour of calves born as a result of artificial insemination. There are now far too many to be seen throughout the country to belie these fears, and some have already done well in the show and sale ring. There is not the slightest sign of discrimination against an animal produced by artificial insemination, even where this fact is definitely stated in the sales catalogue, and already in at least two centres there are bulls in use which themselves were the progeny of artificially inseminated dams.

The attitude of the breed societies

The attitude of the breed societies has changed considerably since the early days. All societies now have rules governing the registration of calves produced by artificial insemination and are only too willing to give help and advice in connection with the selection of bulls for use at centres. One society, the English Jersey Cattle Club, operates a scheme involving the use of semen transported over long distance by arranging contacts between breeders with bulls who wish to sell semen, and owners of cows in other parts of the country who wish to have their cows inseminated from these bulls. At each end of the transaction a private veterinary surgeon normally organizes the operation. There are those among breed society members who do not regret the fact that the widespread development of artificial insemination will mean the end of the sale of quite a number of third-rate pedigree bulls, and there is plenty of evidence in this country and abroad to show that for a very long time to come the practice of artificial insemination will not have an adverse effect on the trade for really good bulls. At the present time the evidence is that it will stimulate it. The development of artificial insemination everywhere depends on the best pedigree breeders providing the bulls required, and never in the past have these breeders had a greater responsibilty.—*Scottish Agriculture*, July 1946.

HOW TO ENLARGE THE FAMILY FARM BUSINESS

By MASON VAUGH

A PREVIOUS article 'What is the Economic Unit in Agriculture?' by Mr Arthur T. Mosher discussed the impropriety of trying to determine artificially the 'Economic Unit' for the family size farm. That article pointed out that the proper size of farm business varies according to the size of family and according to the personality traits of the members of the family, and according to the types of agricultural production in which it is engaged. At the same time, it recognized the necessity of enlarging the size of practically all farm business in India if farm families are to have an adequate standard of living. This article is devoted to a discussion of various methods by which the size of family farm business can be enlarged.

Studies by rural economists and agricultural engineers have shown that, in a uniform type of cultivation, income per worker or per family is closely related to the size of the farm business; the man who alone can cultivate 100 acres will generally have a larger income than the one who, by the same method, cultivates 50 or 25. This is perfectly valid. It is equally true that other methods than the increase in area can increase the size of the farm business and so increase the family income. Some of the ways in which the farm business may be enlarged might be listed as follows:—

1. Increasing the area of the farm.
2. Improving the implements with which the farmer works.
3. Increasing the non-human power per farm worker.
4. Increasing the yield per acre.
5. Improving the efficiency of livestock.
6. Developing a well-integrated and co-ordinated system of farming.

MASON VAUGH is at present Agricultural Engineer, Allahabad Agricultural Institute.

Increasing the area of the farm

The coming of better equipment into use makes it possible for one individual to cultivate a larger area than he could with less efficient implements and without a reduction in the yield per acre. Where there is ample land available and where the fertility of the available land is high, the easiest way to increase the size of the farm business is to increase the area of each farm. This appears to have been the course of developments in western countries, particularly America. It has paralleled a similar development in industry where improved equipment has led to increased output. Before 1800, one man could manage about 30 acres of farm crops in most parts of the then settled U.S.A. and roughly 75 per cent of the population was required to feed the population. When shortly after 1800, improved implements began to be widely available, the size of the farm tended to increase in America mainly by the release of workers from agriculture and the absorption of them into manufacturing, transportation and services formerly performed in the home or not at all. New land was brought into cultivation by the expansion in the population for the most part, though some new land went to increase the size of the farm. This is indicated by the fact that the average size of farm in 1935-1940 was about 155 acres. Exact figures are not at hand, but probably not more than 100-125 acres of this was cultivated, or roughly four times the area cultivated by one man before 1800. This parallels a change from roughly 75 per cent engaged in agriculture before 1800 to roughly 25 per cent in agriculture in 1935-1940. In other words, one farmer had acquired approximately the farms of two others with a small increase from the area added to cultivation. This change has tended to concentrate attention on the effect

of size of farm, outside as well as inside the U.S.A.

Until recently, attention of most agricultural workers in India has been focused on increasing acre yields. Some attention has been given to the consolidation of holdings, in the sense of bringing all the plots owned by one man together by exchanges. Only a few have talked for a long time about the necessity of increasing the size of farms, though it has been popular with politicians to demand an increase in the grazing area. Few if any have indicated clearly how they expected the grazing area to be increased or how the farms were to be enlarged to 'economic areas'. Recently, the changed situation due to the war has led to a demand for 'cooperative farms' as a means of getting 'economic units' for the use of large machinery. It is even being advocated that compulsion be used to bring about such changes.

Can, and if so, how, Indian farms be increased in size and to what extent? The figures quoted in the past have been confused as to the size of farms at present. Two different figures, each perfectly legitimate, have been used, and often confused for each other. One is the average size of holding, the area shown by the land records as being held on some basis of permanent tenure by a cultivator. The other is the area per person under cultivation to crop arrived at by dividing the cultivated area by the population. Naturally, the latter is much smaller than the former. Apparently, some speakers and writers tend to use the latter for the former. We will try to keep the distinction clear in the following:

The area per person of population can be increased by bringing more land under cultivation; if the population increases again, this will in turn again reduce the area per person unless the bringing of more land under cultivation is simultaneously continued. The size of the holding or of the individual farm can be increased by reducing the proportion of farmers to population, that is by combining farms and finding other occupations for the remaining farmers or by the allotment of the increased area under cultivation to existing farmers or by both processes.

First, what is the possibility of increasing the area under cultivation? Again, the figures published by various people vary. The Bombay Plan of Economic Development shows, for all India, 94 million acres of 'culturable waste' land against 208 million acres now under cultivation, a potential increase of 45 per cent. The United Provinces Agricultural Pocket Book shows 9·988 million acres culturable waste and 38·8 million acres now cultivated, about 25 per cent possible increase in cultivated area. This assumes that all the 'culturable waste' is really culturable. The Bombay Plan expresses grave doubt whether it is really all culturable or not. I think this doubt is well founded. However, some extension in area is possible, probably from 25 per cent to 40 per cent, varying from district to district and with methods of cultivation. Certainly much of this land is thin, poor upland of low fertility. If all this land is used to increase the size of farms, the five-acre holding could be increased to one of six to eight acres.

Because of the lack of available new land, the size of the farm can be increased more by reducing the number of farmers than by increasing the area under cultivation. There are various ways in which the number of farmers to be accommodated in India can be reduced. Two may be dismissed at once—a reduction in the population and emigration. There is nothing at present to indicate a reduction in population, though it is urgently necessary to find ways of checking the present tremendous rate of increase. Emigration has been effective in populating vacant areas and freedom of emigration is desirable for other reasons; it has not proven effective in the past in reducing the population of overcrowded areas.

What are the possibilities of such combining of areas? At present about 75 per cent of the population is engaged in farming and 25 per cent in non-farming occupations. If we reverse those figures, we have 25 per cent of the population engaged in agriculture and 75 per cent in non-agricultural occupations; we would then theoretically have one-third as many farmers as at present and each farm could be three times as large as at present. This would mean farms of 15-25 acres for most parts of India. Actually, this situation is complicated by the large number of landless agricultural labourers in India. In many cases there are as many landless labourers as there are 'farmers' having cultivating rights in land. It would be logical that they would be the first to go into industrial employment if such employment were increased or that some of them would take the places of present 'farmers' who might prefer to migrate to

industrial employment. In any case, the increase in area per farm would not be directly in proportion to the change of occupation but much less. Possibly the transfer of 50 per cent of the population, two-thirds of the present agricultural population, to industrial occupation might double the area per farm, assuming a stable population. If we add the 25 per cent increase in cultivated area the new farm might be as much as 2·5 times the present area. This is a useful increase in the farm business but would still leave the farms in the classification of small farms.

Improving farm implements

The effect of the implements used on the size of the farm business—on the profit derived from a holding—has not had much attention in India. In fact, the common attitude of agricultural workers has often been that it is impossible to get along without the old wooden plough and that improved implements were comparatively unimportant. This is a mistaken view. While no one implement will entirely substitute for the old wooden plough, a comparatively simple and low-cost set of equipment will do everything the wooden plough will do, will do it better and will do some things the wooden plough cannot. With such a set, the farmer can cultivate two to three times the area now commonly cultivated as one farm, thus making it possible for 25 per cent of the present population to cultivate the available area suitable for cultivation, including the possible extension of cultivated area.

With mechanized power equipment—tractor-drawn equipment—it is possible for one man to handle up to 150 acres of mixed crops in suitable rotations annually, or 5 to 10 times as much as he can with simple, small, animal-drawn equipment. This also means that the population engaged in agriculture could be proportionately reduced. This may or may not be desirable. Some of the implications of this are discussed in the third article of this series, 'The Cooperative Farm, is it the Solution of India's Agricultural Problem?' There is not space to discuss it here; some implications of these changes will be discussed briefly at the end of this article.

Increasing the yield per acre

The size of the farm business is determined by the amount of crop available through the year for consumption or sale, not by the area cultivated. While increasing the area cultivated will usually increase the amount of crop produced, the same effect in some degree can be secured by improved production per acre. Yields in India are in general low. Improved farm practices such as the use of improved varieties, better rotations, better soil culture practices and in some cases other crops than at present grown can in most cases greatly increase the total crop yield available from a given holding. The adoption of better varieties and of other crops may give increases of 20 per cent to 100 per cent or more; improved varieties are not commonly introduced unless they give at least 25 per cent increase in yield; improved varieties of sugarcane for instance may give 200 per cent to 300 per cent of the old varieties. Vegetables, potatoes, sweet potatoes may give several times the food value per acre, as well as several times the sale value of grain crops. Better soil culture made possible by better implements, particularly better manuring such as green manuring, may double the yield of some crops. The use of commercial fertilizer (chemical manures) may in some cases further increase the yield.

These increases are largely independent of the area cultivated in that they can be applied to larger or smaller areas. By the use of suitable combinations of these means, it should be possible for most farmers to double the size of their farm business. Some of them can be introduced with very small investments, others such as the provision of irrigation will require larger investments. Practically any ordinary village farm can be made to produce at least twice its present output without large investment of any sort. This is perhaps the place where the ordinary farmer by his own initiative and without the necessity of changing social custom, and without government interference, can increase his farm business income most. The changes suggested under this head can all be carried out by the individual, without the necessity for community or government action. There does not seem to be any undesirable social effects of this method of increasing the farm business as there seems to be with some other methods.

Improving the efficiency of livestock

India has a large livestock population which must be maintained on the land. In many

cases, this livestock does not contribute to the farm income as much as it should. Many communities keep buffaloe to produce milk and butterfat, oxen (bullocks) to do the farm work and cows to produce the bullocks. Many animals produce little if anything beside their hides and bones and the conversion of grass into dung for fuel. For the return, the cattle population is excessive and food is lacking to keep them all. Their value to the farm enterprise can be greatly increased by better feeding and by the combining of functions in one animal which are now distributed in several.

The ordinary holding can now support one pair of animals. Since work animals are essential if the farm is to go on, they are the first animals kept. They are usually inadequately fed and often under-developed due to semi-starvation during the growing period. Better cropping and soil management practices will provide more food through increased production. Better methods of storing and utilizing the food, particularly the roughage, will further improve the value of the feed produced. For this, the silo is particularly desirable.

There are several combinations of function which can reduce the necessary number of animals to be kept. Good cows are as efficient in converting food into milk and butterfat as are buffaloes. If instead of buffaloes, cows are kept, they will produce both milk and bullocks. This reduction in animals will leave more food for the remaining animals. Of course, it is necessary to have good animals with good feeding and controlled breeding to maintain and improve the quality of the animals.

It is possible to still further combine functions by using the milking cows as the work animals. This is done on farms in Eastern Europe. With improved implements, the work on the smaller holdings and even the enlarged holdings suggested in the preceding parts of this article, will not require the full time working of the animals. Swiss tests have shown that four hours a day work does not affect the milk yield of heavy milking cattle. It seems likely that a pair of the better Indian milking cows can do all the work necessary on a farm of 15 acres and still give all the milk they are genetically capable of giving, if they are reasonably well fed. This should make possible the reduction of the number of animals now maintained by 50 per cent leaving an adequate fodder supply for the remaining population. While there is religious prejudice against this arrangement, there does not seem to be any religious prohibition of it in any of the scriptures.

Where religious scruples do not interfere, it may be possible to increase the farm business by the keeping of sheep, fowls, goats, pigs, rabbits or other small animals for eggs, meat, wool or fur, or other products. These may be used for the farmer's own food supply or sold. Often a few fowls will produce relatively a large income.

Other ways of increasing the farm business

Two sub-headings remain in our list of ways of increasing the farm businss, 'Increasing the non-human power per farm worker' and 'Developing a well-integrated and coordinated system of farming'. The first has been discussed by the author of this paper in other places and will be referred to in the following article on this series on 'The Cooperative Farm'. The second is too long to discuss here but will be discussed in a fourth article concluding the series. Up till now, agricultural research men and educators in India have largely devoted themselves to piecemeal improvements—the development of a new or improved strain of a crop or of a single new implement. The time has now come when more attention should be given to the coordination of efforts toward the development of systems of farming, with an attempt to find out what is the limiting factor in any system that seems desirable and the concentration of effort toward improving or correcting that factor to make the system feasible. To do this, we must decide what we want to promote, what is socially desirable and technically feasible under existing conditions. We should then concentrate our efforts on making what we consider desirable and feasible as 'economic' as possible. We need 'planning' of the right type in Indian agricultural improvement.

Because of the conditions indicated in the first part of this paper, we must choose between (1) relatively small farms and (2) a very small percentage of the population in agriculture. The average size cannot be large with the existing population and the restricted area available, if we have any considerable percentage of the population in agriculture.

Agriculture is the one remaining occupation in which the individual can exercise his individual ingenuity and work alone. The family

size farm has human personality values that are valuable and should be conserved. For this reason, I believe that plans for agricultural and industrial development should be made on the basis of not less than 25 per cent of the population remaining in agricultural production. On the basis of family farms and 25 per cent of the population in agriculture, the average size of holding could be of the order of three times the present holdings for the present population. Of course, there will be variation unless the size of holding is limited by law. Where conditions are particularly favourable, there will be a tendency to subdivide the land into smaller holdings; where conditions are less favourable, it will be necessary to have larger holdings to get the same income. It may be possible that for some types of farming, in which I mean to include fruit growing, dairying and cattle breeding, we will have to have larger areas in each unit. Before we accept or assume the necessity for such larger units, it would be well to examine very carefully what factors we think make large units necessary. It may be possible to change the limiting factor by research. So much of what we do is the result of habit, empirical and not based on any compelling necessity. The implements and machines we use are so often the result of accident, so far as size is concerned. So little of our agricultural practice has been established by controlled research that almost any practice now in use may be questioned.

If we decide that a certain average size of cultivation unit is the most practicable, or socially the most desirable under existing conditions, the way to maintain or to establish that as the common unit is to make that unit economically feasible or desirable. I doubt the advisability of any reform which must be brought into effect largely by compulsion. While there are undoubtedly ignorant and unintelligent farmers, by and by large farmers will adopt those practices, crops and implements which are demonstrated to be useful and desirable technically and economically. If compulsion is necessary to introduce a new practice, crop or implements, it is probably undesirable. If it is good, demonstration of its value will be enough. I am entirely opposed to the type of planning which results in 'leaders' deciding what is desirable and then applying compulsion to bring it into effect. I am entirely in favour of that type of planning which studies all phases of a question or situation, finds out the apparent necessities, applies research and knowledge to the solution of difficulties and make public the results. I believe in democracy in economic matters as well as in politics. If it is true that, given knowledge, the judgment of the people can be trusted in political matters, it is also true that, given knowledge and help, the farmer can be trusted to adopt those practices, crops and implements which give the best results. If he does not adopt them voluntarily, there is immediate doubt about their value.

While the farmer can and should be trusted to adopt what fits his needs when it is brought to his attention, he does not always know what he needs most nor has he the knowledge to reason out what he needs or how to solve his difficulties. It is the job of the scientist to study the farmer's needs with him, to find out the bases of changes needed and to work out for him the procedures, practices, crops, animals and implements needed to make the existing or practicable holdings economic. These findings must be made known to the farmer. If he then does not accept them, the first thing to look for is the remaining defect or weakness in the supposed improvement.

Mr Mosher discussed the impropriety of trying to artificially determine the 'economic unit' for the family size farm. The article points out that the area of the farm is one of the factors determining the earning power of it but that it may not always be possible or socially desirable to determine the desirable size of farm on the basis of its earning power. It was also pointed out that various other methods beside the increasing of the area may be adopted to increase the size of the farm business. The earning power of the farm may depend more on how it is managed than on its size.

The next article will deal with the cooperative farm and with some of the difficulties commonly overlooked by its advocates.—*The Allahabad Farmer*, Jan.-March, 1946.

Book Reviews

KHANAR BACHAN (Sayings or aphorisms of Khana written in Bengali)

By Devendra Nath Mitra (Published by Development Department, Government of Bengal. Rs. 2-8.)

HERE is a collection of aphorisms connected with the name of Khana. These aphorisms pertaining generally to different aspects of agriculture have been prevalent in Bengal for a very long time. They provided a means of educating the ordinary farmer in agricultural concepts and practices. Useful and practical knowledge of agriculture is a great asset to the poor, illiterate villager who can ill-afford the means of a prolonged training and apprenticeship, not to speak of acquiring knowledge as compiled in learned treatises on the subject. To them the aphorisms mean a storehouse of knowledge which the farmer can draw upon according to his needs. These aphorisms are the outcome of experience and observation and the suggestions contained in them are deemed to be readily applicable to various agricultural operations which they are intended to cover.

The villager or the farmer in India has not much changed with the march of time. He still remains illiterate, still learns from the utterances of the aged and experienced persons around him. He still retains his faith on the words of his ancestors and relies on tradition, as on nothing else to inspire him. The aphorisms are therefore particularly helpful to instil into him ideas and knowledge regarding agricultural practices. Here is a means which with the help of complementary agencies may be profitably employed to convince the farmer of the necessity of a move in a particular direction.

The post-war period is likely to witness a great development and extension of agriculture. The successful execution of the schemes connected with these development and extension work will in the last analysis rest with the farmer. The farmer should therefore be made to realize his position and responsibility in the post-war agricultural development in this country. This would involve propaganda and publicity and agricultural aphorisms may stand in good stead in this connection.

Mr Mitra has done a great service to the country by publishing this book. It contains the aphorisms as they are current; to each aphorism an explanatory paraphrase has been appended which is of considerable help in understanding its meaning and significance. Mr Mitra has been eminently successful in presenting the aphorisms in a comprehensible manner. Appropriate illustration appears on each page conveying the sense of the aphorisms printed on it. The book is neatly printed and the get-up is attractive.—U.N.C.

DOODH (Milk) (in Gujarati)

By N. M. Shah, M.Sc., Ph. D. (Published by the Bharti Sahitya Sangh, Ltd., Ahmedabad, second edition, 1946, pp. 132. Rs. 1-8.)

THE book is a handy treatise on milk and milk products and is a valuable contribution to the scanty Gujarati literature on the subject. The author has presented the matter in a simple language and lucid style making it useful for the general public. The subject has been divided into 22 chapters of which the first six deal with weights and measures, statistics for the five-year period ending 1935 of the cattle wealth of India and Gujarat, of milk and milk products, their import and export figures, qualities of the milk of human beings as well as those of the milk from different kinds of cattle, etc. In the next ten chapters the author has discussed the availability, the methods of manufacture and the nutritive values of milk and milk products like raw milk, condensed milk, pasteurized milk, sterilized milk, homogeneous milk, colostrum, cheese, curd, butter-milk, *ghee*, margarine and vegetable *ghee*. Discussion on the merits and demerits of vegetarian and non-vegetarian diets finds place in chapter 17 while in chapter 18 the author deals with the good or adverse effects of tea, coffee and cocoa. In this chapter he has dragged in tobacco too which is out of place in this book, and so is

the case with the last chapter which deals with food grains, fruits and vegetables. In the remaining chapters the author discusses the effects of alcoholic drinks as compared to milk and presents suggestions for careful feeding and breeding of milch animals.

The book will prove a useful addition to urban, rural and school libraries for inviting public attention to the necessity of production and consumption of wholesome milk, thereby insuring perfect health and longevity.—N.D.V.

SOME BRITISH BOOKS ON AGRICULTURE, NUTRITION, FORESTRY AND RELATED SCIENCES, 1939-45

Compiled by N. M. Bedington (Imperial Agricultural Bureaux Joint Publication No. 11, July 1946, pp. 36. 3s.)

THIS is a very useful publication embracing references on agriculture, nutrition, forestry and related biological and other sciences published during 1939-45. A subject index has been provided so that one can easily find out the work he is interested in. It will be of great service to the workers concerned.—I.C.

FORTIFIES SKIM-MILK FOR YOUNG CALVES

FOR young calves that are being fed from the pail, skim-milk is the standard feed, but one disadvantage is the low fat content of the milk. To replace a part of the fat removed from the whole milk, the Dominion Experimental Farm, Brandon, Man., has evolved a home mixed calf meal which has demonstrated its value. The meal mixture is made up of two parts of finely ground sifted oat chop, two parts finely ground sifted barley chop, and one part of flax seed. The mixture is prepared for feeding by adding scalding water to the meal a few hours before being fed. The mixture when cool forms a jelly, and it is in this form that it is added to the milk. Two heaping tablespoonfuls of the dry meal is the allowance given to young calves. The amount is gradually increased until about one-half pound daily is being consumed. The milk and meal mixture are given in three feeds daily at as near blood temperature as possible. Overloading the calf's stomach is a common cause of scours. In addition to the calf meal mixture, young calves may be self-fed with a mixture of whole oats and bran and they are supplied with good quality hay as soon as they will eat it. Access to a supply of clean drinking water is also important.—*Dominion Department of Agriculture, Ottawa, Canada, Farm News,* No. 560, July 24, 1946.

News and Views

MANGO-SEED KERNEL AS CATTLE FEED

RESEARCH work on mango-seed kernel has shown that it can be profitably used as cattle feed and thus relieve to some extent the great shortage of livestock foodstuff in the country. India has an enormous cattle population and animal nutrition workers are faced with the problem of both quantitative and qualitative shortage of foodstuffs for livestock. According to a recent estimate, the concentrates and the fodder available in the country are sufficient only for 29·1 per cent and 55 per cent respectively of the adult bovine population. This does not take into account the requirements of the equines, of 47·9 million sheep and of 37·7 million goats.

This quantitative shortage of foodstuffs in normal times is felt even more keenly during periods of famine. The Nutrition Laboratories of the Imperial Veterinary Research Institute have intensively explored the possibilities of new sources of foodstuffs, including mango-seed kernel, which is at present mostly wasted. Chemical analysis has shown the kernel to be fairly rich in protein and carbohydrates.

The feed can be prepared by extracting, and slightly crushing the kernel of the mango-seed and incorporating up to three seers of it in the ration of cattle. It has been observed that animals take about three weeks to acquire the taste for the kernel and after that they relish it. Animals are found to have gained in weight and to have developed a healthy appearance as a result of the kernel feeding.

NEED FOR BETTER CATTLE

'I FEEL that one of the greatest needs of the country at the present moment is improvement in the quality of cattle, both for the purpose of getting more milk and for draught' stated the Hon'ble Dr Rajendra Prasad, Member for Food and Agriculture, addressing the Seventh Meeting of the All-India Cattle Show Society at Delhi. 'There has been a great deterioration in both respects', continued the Member for Agriculture, 'and one of the functions which the Husbandry Department has to undertake is to see how we can succeed in improving our cattle in both these respects. Those of us who live in cities naturally think that there is only one thing which has to be taken into consideration when we talk of cattle improvement, and that is the yield of milk. Those of us who live in villages feel that the other point of view needs equal emphasis and in this country no scheme can be of the greatest use to the largest people which does not take into account both aspects of the problem. While improving our breeds for milk yield, which will naturally be confined to the larger cities, we should attach a great deal of importance to the improvement of cattle for draught purposes and milk yield and produce a double purpose animal.

'A society, like ours is serving a useful purpose, because it places before the people samples which they can copy, and although during the last few years it has not been possible to hold the central show, I hope it will be possible now that normal times have returned to revive the central show. At the same time I would not like the provincial shows to be discontinued. I would go further and suggest that these provincial shows should be helped more vigorously. We cannot expect people from great distances to come to New Delhi only for the cattle show, and in Delhi, particularly in New Delhi, I do not know how many people are really interested in cattle except for milk; they are not interested in the cattle themselves. So the real purpose will be served when we bring these best quality cattle before our villagers and encourage and help them to breed better quality of cattle'.

Dr Rajendra Prasad stressed the importance of scientific study and scientific breeding which could be available in special farms which might be started. 'I believe' he said, 'that there are special farms which are being run by Government. It has not been possible for me to acquaint myself either with the farms or their work, but I hope in course of time to do that. The results of experiments must be made available, and that can be done by the use of these cattle. I, therefore, think that it is necessary to continue the work of this Society and to extend it not only in Delhi, but also on a larger scale in the mofussil areas in the country'.

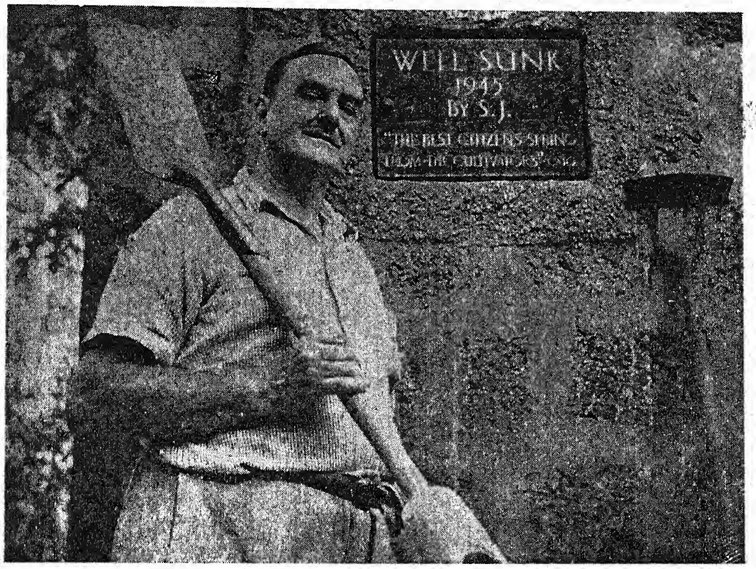
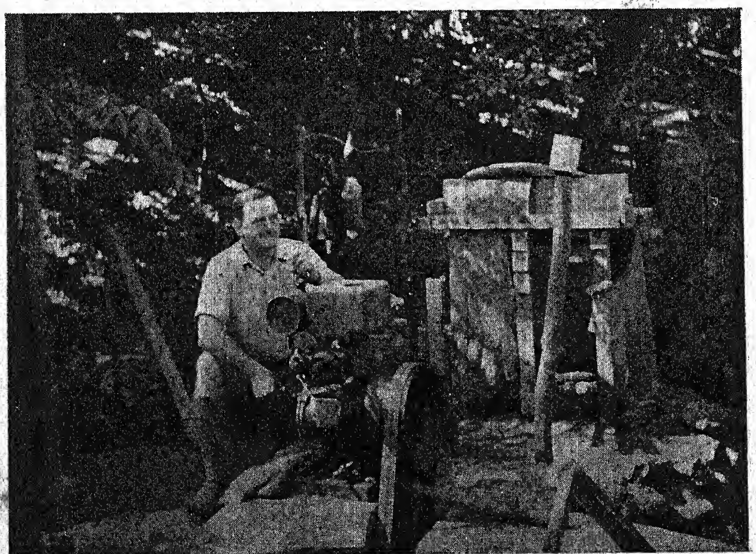


FIG. 1. (above). Mr. Stanley Jepson seen near his well with the inscription from Cato.

[*Photos by Adi K. Sett*]

FIG. 2. (below). Mr. Stanley Jepson seated near his well on his farm at Matheran, near Bombay.



So I wrote to Mrs. Agnes Harler, the author of that excellent book *The Garden in the Plains*. She promised to insert an extra chapter in her next edition, and gave me most useful advice.'

Mr. Jepson picked up a book of useful cuttings and letters, all indexed. I read a letter from Mrs. Harler:

'For some years I lived in Munnar, where we had a rainfall of 200 inches and over condensed within a few months. My experience with the small perennial plants grown in those hills suggested that

(a) big dollops of rain are not so harmful as lesser but more steady and relentless downpours,

(b) beds should be well-raised with particular care as to protective drainage,

(c) plants should be well-spaced to permit of free circulation of air, and

(d) soil should be well-cultivated, kept loose and friable'.

I also read a copy of Mr. Jepson's reply pasted on the next page: 'The pressure of the water on the land is one thing and erosion is another, a dreadful enemy in hill gardens. I forget the figures but I read somewhere that one inch of rain is equal to so many tons pressure per acre. So when 12 in. a day falls, as it does, what does it do to the soil surface? What does it do to the humus put into the garden and how much is washed away?'

In a later letter from Mrs. Harler, I read about lateritic soils, so widespread in India, as being 'greedy for water and organic matter......In the High Range we found that if jungle lateritic soil is cleared and exposed to the sun and rain for a year or two, it loses most of its humus and becomes like coarse brick dust. To keep up the fertility of a laterite in a coffee, tea or rubber estate, calls for heavy shade and frequent green manuring. In a garden there is apparently no alternative to manuring, and I reckoned to add at the rate of not less than 100 tons cattle manure or compost per acre per annum, an amount quite beyond the resources of a plantation of course. I have found that gardening in lateritic soil is far more arduous than working the silty soils of Bengal and Assam.'

'Do you agree,' I asked.

'I don't know Bengal or Assam soils,' replied Mr. Jepson stretching out his muddy boots. 'But I cannot imagine anything more difficult than Matheran laterite, nor should I like to try it'.

DEVELOPMENT OF VEGETABLE SEED INDUSTRY

A CONFERENCE of members of the Central, Provincial and State Departments of Agriculture and the representatives of the vegetable seeds trade in India held in New Delhi recently discussed a number of problems concerning the indigenous seed industry relating to the preparation of a long-term plan for the development of the industry, the enactment of a Seeds and Nursery Act, the future policy regarding import and export of vegetable seeds and the fixation of prices.—*Food Bulletin*, May 5, 1947.

What the Scientists are doing

THE 1947 BATCH OF NEW CO. CANES

THE 1947 batch of Co. canes consists of fifteen canes, Co. 645 to Co. 659 (both inclusive). Two of these canes, viz. Co.651 and Co. 655 fall in the Co. 419 class. Co. 652 is thick and somewhat soft-rinded and though moderate in sucrose it is of possible utility as a chewing cane. Co. 649 is the first cane of Uba Marrot parentage to be released from Coimbatore. It is vigorous but with moderate sucrose. Co. 646 contains in its composition the parentage of Narenga. From among the rich early types Co. 659 and Co. 657 deserve mention. The parentages and general characteristics of these canes are given below :

Sl. No.	Co. No.	Parentage	General characteristics
1.	Co 645	Co. 221 × Fiji B	A medium cane of satisfactory yield and vigour
2.	Co. 646	Co. 213 × [(Vellai × *Narenga porphyrocoma*)] × Co. 205	A cane of good vigour, sparse flowerer
3.	Co. 647	Co. 421 × Co. 312	Vigorous grower and good tillerer; somewhat late in ripening
4.	Co. 648	Co. 421 × Co. 312	Same parentage as Co. 647 but with better sucrose
5.	Co. 649	Co. 508 × Uba Marrot	A very vigorous mid-season cane with moderate sucrose
6.	Co. 650	POJ. 2878 × Co. 312	A medium cane of satisfactory habit and sucrose
7.	Co. 651	Co. 385 × Co. 545	Medium thick, approaching Co. 419 class. Sparse flowerer
8.	Co. 652	Co. 349 × [(POJ. 2725 × *Imperata* sp.)] × Co. 605	Thick cane, satisfactory yield but moderate sucrose. Of possible utility as chewing cane
9.	Co. 653	POJ. 2725 × Co. 301	Moderate height and yield but satisfactory sucrose and relatively less pith formation
10.	Co. 654	POJ. 2727 × Co. 419	A vigorous mid-season cane
11.	Co. 655	Co. 349 × Co. 453	A Co. 419 class of cane
12.	Co. 656	Co. 421 × Co. 453	A Co. 421 class of cane
13.	Co. 657	Co. 453 × Co. 440	A Co. 313 class of cane
14.	Co. 658	Co. 443 × Co. 605	A heavy yielder
15.	Co. 659	Co. 603 × (POJ. 2725 × *Imperata* sp.)	An early maturing type

—I.A.R.I.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. May I know how 'Gillar and Pitto' disease in sheep and goats is caused? Can you indicate a possible line of treatment?

A. As a result of investigation and research carried out, it has been found that the disease 'Gillar and Pitto' in sheep and goats, is not caused by any bacteria, virus or protozoa, but is due to helminth parasites, immature amphistomes. This has been further confirmed by experimental infection of healthy goats with cercariae (larva forms) of the amphistomes.

The snail *Indoplanorbis exustus* found in abundance in low-lying, water-logged swampy areas, acts as an intermediate host and that the disease is acquired by the sheep or goat by eating the grass and leaves infested with the larval forms (metacercatiae) of the above immature amphistomes. So, by destruction of snails, treating the affected animals and preventing them from acquiring further infection the incidence of 'Pitto and Gillar' can be greatly reduced.

The following line of treatment has been found very efficacious for treating 'Pitto and Gillar' in sheep, goats and cattle.

A 10 to 15 c.c. of 10 per cent copper sulphate solution administered by mouth, preferably on empty stomach, and immediately followed by a dose of carbonterachloride, 1 to 3 c.c. for goats and sheep and 3 to 6 c.c. for cattle, the dose of carbontetrachloride depending upon the weight and condition of the animal. The carbontetrachloride must be given mixed in rice gruel or linseed oil. The treatment may be followed with a saline purgative given on the next morning.—P.B.K.

LOSS OF FOUR MILLION SHEEP

MR Tom Williams, Britain's Minister of Agriculture, stated on April 28 that four million sheep and lambs—well over 20 per cent of the total flock—died in the blizzerd that swept England and Wales two months ago. This 'national disaster' would affect home-produced meat supplies for several years ahead, the Minister added.—*Food Bulletin*, May 5, 1947.

What's doing in All-India

MYSORE

M. MALLARAJ URS

THE distribution of rainfall in the early part of the south-west monsoon was fairly even throughout the State. Prospects of a good harvest were however unfortunately spoiled by the unexpected showers in the harvest period. The rain fell throughout the State and did considerable damage to the crops. Earlier in the season, the paddy crop particularly had been attacked by *Leptispa pygmae*. This was however effectively checked by the timely relief measures taken by the Agricultural Department of the State. Special staff had been sanctioned for the purpose and large quantities of kerosene oil were supplied to the ryots for controlling the pest. It is estimated that about 10 to 15 per cent of the crop has been damaged by the untimely rainfall during harvest season and insect attack earlier in the season.

'Grow more food' campaign

With a view to encourage the ryots to grow more food crops the Government granted a very large number of concessions during the year 1946. Seeds, manures and implements were stocked by the Agricultural Department in their depots throughout the State and distributed at concession rates. Groundnut cake powder was sold at 75 per cent of the cost price and other manures, such as ammonium sulphate, bonemeal and supers were sold at 50 per cent of the cost price. To those who intended to purchase seeds and manures on credit, facilities were provided by the Agricultural Department and arrangements made for recovery of the cost of these manures so issued either in cash or in kind after the crop was harvested. In addition to these general concessions, special concessions were shown to ryots under channels and tank areas. In the Irwin Canal Area the cultivation of irrigated ragi (the staple food of the State) was encouraged. Seeds and manures at a cost of Rs. 1,20,000 for an area of 8,000 acres were issued free of cost in the first instance. Later, these concessions were extended throughout the State for all ryots who grew irrigated ragi. A scheme at a cost of Rs. 7,00,000 for encouraging cultivation of irrigated ragi by lifting water from the wells was sanctioned. The Government were pleased to sanction a subsidy of 50 per cent of the estimated cost of erection of wells dug by the ryots before June of last year provided the total cost of the well did not exceed Rs. 500. To those ryots who had already installed electric pumps or intended installing them, concessions by way of reducing the rate per unit of power consumed and purchase of sets on instalment basis were sanctioned. Further, a bonus of Rs. 2 per palla of 100 seers has been sanctioned to those who grew irrigated ragi by using the water from the wells. Prizes of the value of Rs. 4,000 were awarded to the best ragi-growers in the Irwin Canal Area. The staff of the Department was increased for the purpose of effective supervision at a cost of Rs. 1,36,000 under the 'grow more food' scheme.

M. MALLARAJ URS is Secretary of the Committee for Agriculture, Bangalore.

Manufacture of compost

The scheme for the manufacture of compost from town-refuse, which had been sponsored by the Indian Council of Agricultural Research for a period of two years from 1943, terminated last year but in view of the great importance of the subject both from the health and the manurial point of view, the Government of Mysore have extended the scheme for a further period of three years. The scheme envisages the stabilizing of the work already taken up in the 36 centres and organizing a distribution system, for the *rabi* and *kharif* seasons of 1946 and also the training of the 18 sanitary inspectors who are to take up the work of preparation

and disposal of manure in the various municipalities in the State. About 29,000 tons of compost were manufactured and distributed last year.

Post-war schemes

Agricultural College: The Committee for Agriculture considered a number of schemes relating to the post-war development of Agriculture, Veterinary, Forestry, and Co-operative and have recommended them to the Government for sanction. These schemes involve the employment of a large number of men trained in agriculture and with a view to provide adequate staff for working these schemes, the Government have sanctioned the establishment of an Agricultural College at Hebbal, four miles from Bangalore, at a cost of Rs. 7,00,000. The first year course started in July 1946 and 38 students have been admitted to this course. The College is affiliated to the University of Mysore and the duration of the course is of three years, at the end of which the successful candidates will be awarded the B.Sc. Degree in Agriculture.

Agricultural Experimental Farm: The malnad districts of Shimoga, Hassan and Kadur along the Western Ghats are the granaries for paddy in the State. More than half the area under paddy lies in these districts. With a view to improve the cultivation methods and also to evolve high yielding strains of paddy, an Experimental Station has been opened at Anandapuram in Shimoga District.

Fisheries: With a view to develop the fishery resources of the State, a scheme for conservation, stocking, exploitation, transportation and marketing of fishes has been sanctioned. The scheme envisages the establishment of conservancy in the spawning grounds of food fishes and below the dams of big reservoirs where the fish congregate while migrating, legislation against destructive fishing, licences for fishing and colonization of Krishnarajasagar area with fishermen and transportation and marketing of fishes.

The starting of an aquarium at Krishnarajasagar at a cost of Rs. 1,40,000 has already been sanctioned in January last.

New veterinary dispensaries: In order to provide veterinary aid on the lines envisaged by the Royal Commission on Agriculture and with a view to preventing the large mortality of the cattle due to the outbreak of rinderpest and other cattle diseases, a scheme for the opening of more veterinary dispensaries throughout the State was recommended to the Government and has since been sanctioned. As per this programme it is proposed to open 105 more veterinary dispensaries at a cost of Rs. 4,98,015 during the next five years. This is in addition to the existing 94 veterinary dispensaries in the State. Arrangements are in progress for opening 21 dispensaries during the first year of the programme.

Dairy farms: With a view to overcome the acute shortage of milk in the larger cities of Bangalore and Mysore and to improve the dairy herd in the State the Livestock Sub-committee of the Board of Agriculture have recommended to the Government among other things the starting of three dairy farms in the State at different centres. The total estimate of these schemes is Rs. 6 lakhs. Pending consideration and orders on the scheme the Government have, in the first instance, sanctioned the purchase of 100 Sindhi cows and 4 bulls at a cost of Rs. 80,000 during 1946 and further approved the purchase of 25 cows annually during the next four years. A dairy farm will, in the first instance, be started at Hesarghatta, about 16 miles from Bangalore, which will be the nucleus of the Sindhi herd for the State.

Dry Cattle Farm: A scheme at a cost of Rs. 43,000 for the establishment of a Dry Cattle Farm at Hesarghatta has been sanctioned by the Government so as to accommodate 100 dry cows in the first instance. Arrangements are being made to start similar farms in convenient places round about Bangalore City so as to help the dairy cattle breeders in the State.

BARODA

T. V. MULYE

THE indigenous inhabitants known as Raniparaj reside in Tilakwada Mahal (part of district) of Baroda District and also in parts of Navsari District. The people are simple, unsophisticated, illiterate and lack the initiative of a cultivator. The money-lenders ever greedy to pick up opportunities to serve their own greed, slowly purchased the lands of these people and subsequently leased the same lands to the people on a higher rent. This resulted in reducing the original owners to the state of serfs. Any incentive to a greater production on the part of those who till the land is non-existent. Production is thus as low as is to be expected when the tiller of the land has no incentive and the land-lord has no agricultural knowledge or interest.

Rehabilitating the village

To remedy this state of affairs the State has directed its attention to restore the original cultivating class to their lands by a scheme in collaboration with the Imperial Council of Agricultural Research. It will be known as Village Rehabilitation Scheme. The object of the scheme is to rehabilitate a number of farmers of backward class on lands from which they have been ousted by the money-lenders. These lands will be acquired by the State prior to colonization. A study of economic results will be made to observe the influence on the cultivators themselves of different forms of land tenures and land operations.

A start has been made in five villages from 5 February 1946 round about Amroli in Tilakwada Mahal. The lands have now been acquired and detailed work for cropping will begin from the ensuing winter season.

Preservation of food grains

The preservation of food grains against the ravages of the insect pests has been engaging the attention of every body. This problem has been to the forefront due to the shortage of food. Every household is confronted with the difficulties in safeguarding the grains against the encroachment of the insects. Often they are stored in whatever conditions as they are purchased from the shops. The average householder is averse to using preservatives partly because of the lack of knowledge about their use and partly due to their non-availability.

The cheapest and most economical way to store these is to thoroughly sun-dry the seed. The grain is spread in a thin layer and turned occasionally and allowed to be exposed to the sun heat for at least four hours. Towards the evening all grains are collected and when cool, stored in air-tight containers. The containers may be made of earth or tin. These should also be well-cleaned and dried before they are filled with the grain. After filling is done, the lids are closed up air-tight.

Soil conservation

A modest beginning has been made towards the study of soil conservation methods on a block of land four square miles in area and about three miles north of the town of Dhari in Kathiawar which is fairly typical of large tracts of denuded and eroded countryside found in that area. The preservation and improvement of the soil-cover is being tried with the various accepted methods, viz. contour trenching, gully plugging, improvement of grass cover and establishment of trees. The work is in progress for the last two years and has given encouraging results. The contour trenches have served their purpose of checking the run off very effectively and are gradually silting up. A useful cover of grass is being established in and around them. To-date 25,000 trees have become established in spite of the depradation of wild animals and damage caused by fire.

T. V. MULYE is Technical Assistant to the Commissioner of Agriculture, Baroda.

UNITED PROVINCES

H. S. SANDHU

DURING the quarter ending 31 March 1946, the Department of Agriculture concentrated its efforts in the storing of *kharif* seed stock. A total of 105,266 md. of seed was realized and 15,459 md. purchased and properly stored. The other activities are given in the following tables.

TABLE I

'Grow more food' activities

Culturable waste ploughed	Interest-free Taqavi		Wells constructed	Implements distributed	Manures and fertilizers distributed		*Sanai* seed distributed for green manuring
	For breaking land	Purchase of bullocks and implements			Oilcakes	Fertilizers	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2,528 acres	Rs. 56,800	Rs. 92,452	35	2,526	40,950 md.	15,469 md.	899 md.

TABLE II

Daulbandi and Cooperative Composting Scheme

Area Daulbanded	Compost prepared	Subsidy given
95,175 acres	1,055,252 md.	Rs. 9,600

Seventeen cattle shows were held and 'farmers week' celebrated to make the public conscious of the better methods of animal breeding and agriculture. The process of manufacture of improved *gur* was demonstrated and 268 improved furnaces were constructed. A total of 9,230 md. of jaggery was manufactured. The importance and use of clarifying agents was particularly stressed upon.

H. S. SANDHU, Major, is an Officer on Special Duty, Department of Agriculture, United Provinces.

The Superintendent of Government Gardens continued to utilize the lawns and other parts of Government and public gardens for growing food crops. Experiments conducted show that berseem can profitably be sown with paddy for supply of green fodder. The *Phulva* variety of potato has proved superior in yield to *Majestic*. As a result of crosses in 1934 a hybrid 87-1 has given good performance and is being multiplied for distribution. Its grain is bold and combines early maturity with high yield.

FEEDING TAMARIND SEEDS TO CATTLE

M. RAMAKRISHNAN

WHEN I was at the Veterinary Hospital, Chittoor, a client came to me sometime during June 1945 and asked my advice regarding the value of feeding tamarind seeds to his cattle since oilcake, bran and *dhal* husk, etc. were not easily available. I encouraged him to do so, but instructed him to keep me informed of the results of feeding both to work and milch cattle every now and then.

M. RAMAKRISHNAN, G.M.V.C., is Veterinary Investigation Officer in Madras.

The client mentioned above is a firewood-shop owner and he is also running a small private dairy. He has four pairs of work cattle, ten buffaloes and two cows for milk

production. He also collects milk from other milkmen and sells it at a marginal profit. The owner started the feeding of his work and milch cattle with tamarind seeds. In about three or four days, there was a slight increase in the milk yield of cows in almost all the animals by one to one and a half ollocks (8 to 12 oz.). In about ten days, the increase rose up to 3 ollocks (1½ lb.) in two animals and 4 ollocks (2 lb.) in eight animals. In the work cattle there was a decided improvement in condition. He continued it for about six months. The increase in milk yield and improvement in condition were kept up. He had to stop this feed suddenly for want of tamarind seeds. In about a week or 10 days' time, the yield had gone down even one or two ollocks (1½ to 1 lb.) below the normal yield which the animal was giving before the feeding of tamarind seeds. In work animals, the loss in condition was noticed and the coat had lost its glossiness. Immediately the owner paid a heavy price for tamarind seeds and renewed the feeding. He found that the original increase in milk yield was restored shortly.

The owner encouraged by the results obtained by tamarind seed feeding advocated its use to his friends and milk suppliers. The following is the milk record of two buffaloes fed with tamarind seeds, belonging to one of the suppliers who supplies milk to the above dairy. Of the two buffaloes, Buffaloe A, aged 6 years, was in the tenth month of lactation and had no calf. Buffaloe B, aged 7 years, was in the third month of lactation and had a calf. The average milk yield before tamarind seed feeding was about 6 ollocks (3 lb.) in the morning and 5 ollocks (2½ lb.) in the evening for Buffaloe A, and 8 ollocks (4 lb.) in the morning and 7 ollocks (3½ lb.) in the evening for Buffaloe B. The feeding was started on 10 July 1946.

The following table shows the milk yield in two buffaloes:

Date	Buffaloe A		Buffaloe B	
	Morning (in ollocks)	Evening (in ollocks)	Morning (in ollocks)	Evening (in ollocks)
10-7-46	7	5	8	7
11-7-46	7	6	9	8
12-7-46	7	7	9	8
13-7-46	7	7	9	8½
14-7-46	7	6½	9	8½
15-7-46	7	6½	9	8½
16-7-46	7	6½	9	8½
17-7-46	7	6½	9	8½
18-7-46	7	6½	9	8½
19-7-46	6½	5	8	7
20-7-46	6½	6½	8½	7½
21-7-46	7	6	9	7½
22-7-46	7	6	9	8
23-7-46	7	6	9	7
24-7-46	7	7	9	9
25-7-46	7	7	9	9
26-7-46	6	7½	8	9½

Note: 1 ollock=8 oz.

From the actual readings available it is evident that there is a distinct increase of 1 to 2 ollocks (½ to 1 lb.) in each of the animals per day, though the dairy-owner who first started the feeding claims that it is even more. The work animals were actually visited by me both before and after the feeding with tamarind seeds. The improvement in condition was really striking. These are merely rough and ready observations, but give some indications to the effects of feeding tamarind seed.

Method of use

Tamarind seeds are first roasted. Then their covers are removed by a rice huller. The seeds are then powdered. It does not matter if it is a little coarse. About three Madras measures of the powdered seed in the morning and similar quantity in the evening are fed to each adult animal. About 1½ to 2 hours soaking in water is sufficient. A longer duration will set up fermentation which some of the animals may not like.

AN OUTSTANDING HARIANA COW OF THE INDIAN VETERINARY RESEARCH INSTITUTE DAIRY, IZATNAGAR

A. N. GAUTAM

IT is well-known that Hariana is one of the best 'dual purpose' breeds in India. Males of this breed are renowned for stamina, while cows are reputed for good milk yield. Attempts at improving the milk output have shown that by the application of improved methods of dairy husbandry, the present capacity for milk production in this breed can be substantially raised.

Serial No.	Date calved	Date of drying	Lactation yield lb.	Days Wet	Days Dry	Remarks
1	16-12-35	16-10-36	4858	305	104	Lactation yield at Karnal
2	21-1-37	28-1-38	6111	372	73	Lactation yield at Izatnagar
3	11-4-38	14-3-39	4706	337	173	
4	3-9-39	-9-40	4940	365	160	
5	11-2-41	6-1-41	6121	329	64	
6	10-3-42	14-12-42	5118	279	88	
7	12-3-43	17-1-44	4846	311	10	Suffered from Foot-and-Mouth Disease
8	27-1-44	28-9-44	2222	244	124	
9	30-1-45	2-2-46	5884	368	..	

One of the research activities of the experimental dairy at Izatnagar, is to study the genetical bearing *vis-a-vis* the ceiling of milk production in Hariana breed. This has necessitated the establishment of a nucleus of outstanding animals out of the existing herd. Cow Chatni, No. 78, is an important individual of this nucleus. She was born on 28 August, 1931, at the Cattle Breeding Farm, Karnal (now Agricultural Sub-Station) to sire Colonel and Dam Harfi. Chatni calved for the first time when three years old. The calf was weaned. Her performance record is given above.

From the date given above it is obvious that although Chatni is not outstanding at the pail, yet being a remarkably regular breeder with short dry period, she can claim a top position amongst the best cows of her breed.

The calves produced by Chatni are all females excepting two born on the fifth and eighth calvings. Out of 7 females, 4 have calved and proved to be very good at the pail. Total yields of the daughters in the first lactation are 4658 lb. in 293 days, 6422 in 315 days, 4204 in 313 days and 4299 in 377 days. The first male calf which has been retained for breeding purposes, proved to be very good bull. Other good points in favour of Chatni are splendid constitution and breeding efficiency which are unimpaired even at her present age of fifteen years.

Across the Borders

RAINS OF FISHES-MYTH OR FACT?

By E. W. GUDGER

BEING particularly interested in all the unusual things that fishes do and that happen to them, I have for over 40 years been collecting and publishing accounts of such matters, from laymen observers, from scientific men, and from my own experience. In all these articles I have sought to evaluate the evidence and to give credence accordingly. My reports are accredited by my scientific colleagues everywhere.

In the *Atlantic* for April 1946, Bergen Evan, Professor of English at Northwestern University, writes that 'the little fishes that come in heavy storms are one of the most delightful.... myths,' and further on he refers briefly to one report of a 'rain' in my first article (1921). This particular fall occurred in India in 1830. The English reporter had the 10 Indian farmers who saw it attest their reports in 1-2-3 order before a magistrate, and their accounts are so printed in my article. Of Nos. 5 and 8 Prof. Evans says: 'Some of Dr Gudger's more reliable witnesses make the interesting point that the fish that descended on them were headless, and partly eaten—suggesting birds to the incredulous, and God knows what (a rain?) to the credulous.'

What Prof. Evans does not note is that these two 'more reliable witnesses' also state that some of the specimens were 'fresh'. Furthermore, he also fails to note that, of the eight other (unreliable?) witnesses, five state that they saw the fishes fall, and No. 5 (a 'reliable' witness above) had a fish fall on his head. Furthermore, three men (including Prof. Evans' No. 5 above) picked up fresh fishes and carried them away. All these and the accounts of 43 other reporters in this article (among them James Prinsep) are disregarded by Prof. Evans. He picked out the evidence he wanted, but was 'incredulous' of all the other.

In my first article (1921), which seems to be the only one of the four seen by Prof. Evans, I made an attempt to evaluate the evidence. Some accounts were put down as hearsay and some as hearsay pretty well-attested. Others come from men who found previously dry receptacles filled with rain water and fishes—among them, James Prinsep (1833), long Secretary of the Royal Asiatic Society of Bengal, who 'found a small fish, which had apparently been alive when it first fell in the brass funnel of my pluviometer at Benares, which stood on an isolated stone pillar, raised five feet above the ground in my garden.' Some of the various reporters saw the fishes fall, and some had the fishes strike their heads or bodies. Among those who did not witness the falls were scientific men of high standing and veracity who, after carefully investigating the alleged rains, accepted the accounts as credible and whose printed word is today accepted by scientific men. Prof. Evans makes no mention of these.

The explanation is to be found in the action of whirlwinds and waterspouts and possibly of strong typhoon and monsoon winds. A 'twister' or whirlwind starts in front of an approaching storm, and as it gains in size the 'snout' elongates and approaches the water. This, caught by the whirling wind, rises up in a cone. The two unite, and the swirling column moves along, picking up water, fishes, and any other fairly light objects at or near the surface of the water.

I have seen waterspouts off Beaufort, North Carolina, and numerous ones in the Florida Keys west of Key West. In these latter, on a day in July 1914, at the Marquesas Atoll, a huge waterspout was seemingly headed for the yacht on which I had been left as ship-keeper, but when near at hand it fortunately

sheered off and passed by about 100 yards away. To this day I have a vivid recollection of the irresistible power of this whirling wind and water. A natural history correspondent in Louisiana (E.A. McIlhenny, of Avery Island) once wrote me of a small waterspout on a freshwater distributary in the Mississippi delta, which broke just in front of his fishing boats and then filled boats with water and fishes. He knew of other like phenomena in that region. Such a waterspout might pick up dead fish (if such were present) as well as live ones. Everything movable would be sucked up in the whirling vortex. Furthermore, whirlwinds, originating inland, will not only progress over land, picking up various objects, but over ponds and lakes—becoming waterspouts. As such they will there pick up frogs, freshwater fishes, snails, etc. and carry these away over the land. Sometimes the fishes are found in a long, narrow, fairly straight row over some distance, evidently having been dropped as the waterspout progressed over the country with lessening speed and carrying power.

When the waterspout or whirlwind, with its load of fishes, breaks, or when these and the typhoon and monsoon winds lose their velocity to a point where their carrying power is less than the pull of gravity on the fishes, water and fishes will fall as a 'rain of fishes'.

In my four collective articles about 78 reports are noted. Their time span is about 2,350 years, and their range in space, the six continents and various islands in the two great oceans. Recorded are rains from Canada (5), United States (17), England (5), Scotland (9), Germany (11), France (1), Greece (1), Paroe Island (1), Holland (1), India (13), Malaya (2), East Indies (2), Australia (7), South Africa (1), South America (1), Scandinavia (1). These accounts have been collected from works on meteorology, history, travel, and natural history and from various scientific journals, mainly those devoted to natural history in general. These accounts were written by all sorts and conditions of men—ordinary citizens, persons interested in natural history, and scientific men of high reputation for veracity and for accuracy of observation. Among the latter are James Prinsep, already mentioned (1833); C. W. Grant (1838) of the Bombay Engineers; J.E. Dekay, in his *Fishes of New York* (1861); Pieter Harting (1861); Sir Emerson Tennent, in his *Natural history of Ceylon* (1861); Count Castelnau, the ichthyologist (1861); E. Warren, of the Natal Museum, South Africa (1909); Alexander Meek, of the Dove Marine Laboratory (1918); and J.D. Ogilby (1907) and A.R. McCulloch (1925), well-known Australian ichthyologists. These men not infrequently narrated these accounts before scientific societies and later published in scientific journals.

Most of the non-scientific observers and some of the scientists had no knowledge of what other men in their own lands and especially in foreign countries had seen and written about. Some of the observers had seen the fishes while falling, some had been struck by the fishes, and some had eaten of the freshly fallen fishes. The mass of evidence is as prodigious in volume as it is widespread in time and space. To disregard all this evidence ranging from hearsay to scientifically attested, and to brand as 'credulous' all those who, from personal observation or after much study of published accounts, accept much of it as credible, seems, as I wrote in Article I, to indicate a refusal to consider the evidence offered or an inability to evaluate it.

To my very great regret I have never witnessed a rain of fishes, as I have never seen some of the other unusual and extraordinary things about fishes of which I have written in the past 40 years. But if such things have not been physically impossible, and when after careful and critical consideration of the reports (from hearsay to scientific) from widespread sources the world around and from many reputable observers (some known to me personally)—reports which in detail corroborate each other, then I have ample justification for giving them credence, and so I still believe that: Fishes fall from the sky with rain.—Reproduced from *Science*, June 7, 1945.

Home Gleanings

CATCH MORE FISH

TO a world afflicted with a chronic food shortage the gems in the ocean have only a lesser appeal than the fish in it. The countries which have harnessed the discoveries of science to the development of nature's resources have successfully tapped to the full marine food supplies available to them. In India, neither the Government nor private enterprise had taken advantage of the enormous supplies in fish that could be obtained from the sea and the inland lakes. It was only when the war led to critical shortages of food supplies and the food situation refused to yield to mild and hotch-potch treatment, that authorities in India started recognizing the need for planned investigation and development of the varied food resources available to the country.

Potential fisheries

An idea of the country's resources in fish was recently given by Dr Baini Prasad, Fisheries Development Adviser to the Government of India, in a recent broadcast talk from Delhi. In addition to extensive inland fisheries, India has a fishable marine area of some 100,000 square miles along a seaboard some 3,200 miles long. It is possible to acquire from this vast area an annual catch of not less than two hundred million maunds of fish, having a total value of Rs. 110 crores. But for the present, these figures are only a distant target. Hither-to only 10,000 square miles of the sea have been exploited and the annual catch hardly exceeds one hundred and seventy lakh maunds, having a value of Rs. 10·45 crores. This means that fish production in the country could be stepped up by at least 10 times what it is now.

Low per capita *consumption*

Dr Baini Prasad tells us that nearly 50 per cent of India's population are fish-eating. This does not mean that all these get enough fish to eat or get whatever is available at prices which the bulk of the consumers can afford to pay. It only means that this large proportion of the population is accustomed to eat fish or is willing to do so, provided fish can be had in sufficient quantities and at reasonable prices. The present production of fish yields only less than a chhatack per head per week and even this available at prices beyond the reach of the average consumer. The results of the techno-logical work carried on by the Fish and Wildlife Service of the United States have shown that half a pound of salmon contains 7 per cent of the daily calory requirement of an adult, 40 per cent protein, 5 per cent calcium, 29 per cent phosphorus, 10 per cent iron and 2 to 10 per cent of iodine. Many varieties of fish are much less rich in nutrition content than the salmon. In the circumstances, it is impossible to claim that on average fish has yet come to occupy the status of a staple food for the masses in India. Even in the maritime tract on the west coast, where the consumption of fish is the highest the *per capita* consumption figure does not exceed a maximum of 17 lb. per year. The figure for Bengal is 6·73 lb., for Assam 3·64 lb. and for Bihar it is 2 lb. The consumption of particular sections and individuals in these areas may, of course, reach enviable levels.

Increase in production possible

It need hardly be said that at present fish production lacks most of the features of an organized industry. It is gratifying to note from Dr Baini Prasad that both the Central and Provincial Governments have applied themselves with vigour to the task of expansion. Though Fisheries Departments were started in a number of provinces and States within the last 40 years, for want of requisite trained staff, essential biological, hydrological and statistical data, research and experimental facilities, they have not been able to serve as efficient agencies

for the improvement and development of fisheries. As a result of the recent 'grow more food' campaign of the Government of India, various *ad hoc* schemes for increasing fish production with the help of the Central Government were started since 1944 by the provinces and States. We are not told how much new fish has already been caught through the operation of these schemes. But Dr Prasad estimates that an yield of 17,000 tons of sea and fresh water fish per year would become available as a result of these schemes.

Aid from the Government

The Government of India have now taken up the question of starting scientific investigations in order to put the fisheries of India on a sound foundation. Besides starting fisheries service and investigations on selected subjects at the existing fishing and research centres, a Central Fisheries Institute is also under consideration. A scheme of pilot fishing will soon be launched to find out the most suitable craft and gear for use in Indian waters. The Government have ordered for four different types of modern fishing vessels together with equipment from the U.S.A. and the U.K., and it is intended to work these vessels with master fishermen and trained crew from abroad, so that Indians may be trained in the technique of power-fishing. Facilities are also being given to the fishing trade for importing fishing craft and gear, ice and cold storage plants.

It is disclosed that the Government of India are providing increased facilities for fishermen in Bombay, Bengal, Sind, and Travancore to obtain timber, yarn, sail-cloth, coal, fish-hooks, ice for preservation, and finally motors and engines to be fitted on to fishing boats to enable them to transport fish as quickly as possible from distant fishing grounds.

While the work done by the Government deserves appreciation the public will naturally be anxious for better and quicker results. If Dr Prasad's estimate of the marine food potentialities of India would provide an inspiration for a more vigorous application of the policies already decided upon, it will quicken the pace of realization of internal self-sufficiency in food considerably. We have it from Dr Rajendra Prasad that by 1951 under the existing levels of production, the country might fall short of 7 million tons of cereals. If during the interval fish production can be stepped up to two hundred million maunds per year as is considered possible, it will obviate a large part of the increase in production deemed necessary for cereals.

Eat more fish

Fish and cereals may not be interchangeable fully but the consumption of one cannot but affect that of the other. It is not entirely out of range of possibility that those who are not habitual fish-eaters to-day may be tempted to convert themselves into a more nutritious creed in the future. Khan Abdul Gani Khan, M.L.A. (Central), has offered the suggestion to the vegetarians in South India.

Of all varieties of protein food, fish is among the least costly. There is no need to plough or sow or to look for propitious seasons. Nature yields a bountiful crop for next to nothing. Man has only to catch and eat. There is, however, one colossal threat to the world's fish supplies—the atom bomb experiments. But the pressure for food may mean that even if the nations do not disarm, atom bomb demonstrations may be discarded.—Reproduced from *Indian Finance,* January 18, 1947.

Book Reviews

THE FORAGE RESOURCES OF LATIN AMERICA—El SALVADOR

By JAMES M. WATKINS (Published by the Imperial Bureau of Pastures and Forage Crops, Aberystwyth, Great Britain, 1946, pp. 24, 2s. 6d.).

THIS is the first of the series on the forage resources of South America. The bulletin is interesting and useful. It gives description of forages of El Salvador where 'the use of silage is almost unheard of in some localities and the preservation of feed as hay is not practised to any great extent'. Moreover, 'many of the pastures are at one or other extreme, overgrazed or undergrazed'. The conditions have much in common with India and the use of more legume, more grass-legume mixture, development of efficient pasture, the preservation of fodder for dry seasons are as much problems there as in India. The bulletin cites references of previous authors and gives description of 22 grasses, 10 legumes and 3 miscellaneous fodders. Amongst the grass family, Rhodes grass (*Chloris gayana* Kunth), Guinea grass (*Panicum maximum* Jacq.), Dallis grass (*Pespalum dilatatum* Poiret), Napier grass (*Pennisetum purpureum* Schum.), Sugarcane (*Saccharum officinarum* L.), Sudan grass (*Sorghum vulgare* var *Sudanese*), Sorghum (*Sorghum vulgare* L.), Maize (*Zea mays* L.) are crops grown in India. In the case of maize the main crop tnere is sown in May-June and the second crop is often planted in August or September, a third crop is grown in certain localities in October or November for summer feed. Johnson grass (*Sorghum halepense* L.), has been said to offer good feed but has not been recommended as it is very difficult to control when it is once established. This grass was tried in India and other British territories but, as Sampson points out, its cultivation has practically ceased because its root habit makes it difficult to eradicate and the plant may be poisonous when the shoots are young or when stunted by growth. Another grass, viz. Molasses grass (*Melinis minutiflora* Beauvais) is of interest to India as it is said to remain green throughout the dry season, it does well on poor soil and is relished by the stock. It is also reported that this plant is repellent to ticks. The plant thus has both insecticidal and fodder values and is worth trying in India.

In the case of Bahia grass (*Paspalum notatum* Flügge), it has been said to offer promise as an upland pasture in the same category with Carpet grass and Dallis grass. In India the seeds of this grass were obtained from Australia and grown in the Division of Botany, Imperial Agricultural Research Institute, New Delhi in 1941. The plant is growing since then as a perennial grass, but the growth has not been promising. It however flowers and sets seeds all right and is a hardy grass. From the habit of the plant (reduced stems and large number of leaves crowded at the base) it appears to be useful for soil conservation purpose.

Amongst the legumes, Pigeon pea (*Cajanus indicus*), Sword bean (*Canavalia ensiformis* L.), *Dolichos lablab* L., Beans (*Phaseolus vulgaris* L.), and Cow pea (*Vigna unguiculata* L.) are grown in India.

Amongst the miscellaneous plants, *Crescentia alata* is a tree fodder. The fruits which drop to the ground are eaten whether green or in a fermenting condition by the stock during the dry season, and in certain areas in this season they form practically the only source of cattle feed. It is stated that the good quality of cheese coming from the Department of Chalatenango is attributed to their fruits being eaten by the animals. This tree is said to grow at elevations of 100 to 600 meters. It is not known whether it grows in India but it may be worth while to try out. The other miscellaneous fodder of interest to India is banana (*Musa sapientum* L.) which is also extensively grown in India though primarily for fruit.

The bulletin concludes by indicating six immediate problems for improving the forage situation which seems to have a close similarity with India. These problems are (a) the use of more legumes, (b) the use of more grass-legume mixtures, (c) the development of more efficient pasture management, (d) the use of lime and fertilizers, (e) the development of forage for particular conditions, and (f) the all-inclusive

matter of producing and preserving more feed for the dry season.

Some of the botanical names are not found in *Standardised Plant Names* and in some cases synonyms have been used in places of correct botanical names.—I.C.

THE INDIAN COTTON TEXTILE INDUSTRY (1945-46 ANNUAL)

Edited by M. P. Gandhi (Gandhi & Co., Jan Mansion, Sir Pherozeshah Mehta Road, Fort, Bombay).

THE Annual reviews important developments in the Indian Cotton Textile Industry during 1945-46 with informative details regarding the various aspects of the industry. A new feature is the inculsion of information on the development of the synthetic fibre industry which should be of interest in view of the growing competition that faces cotton from this source. The post-war prospects of the Indian Cotton Textile Industry are also dealt with at some length.

The main review is preceded by 23 statistical tables dealing with the progress of cotton mills in India, production, imports and exports of raw cotton, cotton yarn and cotton piecegoods. Mention may be made of the table showing the *per capita* consumption of cotton piecegoods in India during 1944-45 as compared with previous years. In 1944-45, this works out to 15·10 yards *per capita*, against 15·20 yards in 1943-44 and 12·40 yards in 1942-43.

Three useful appendices follow the main review; the first deals with information relating to cotton cultivation, exports, imports, consumption, prices, etc., the second with details about the handloom industry and the third appendix contains a list of cotton mills in India, giving the names of Managing Agents, number of looms and spindles installed, etc.—D.N.M.

HONEY CRAFT IN THEORY AND PRACTICE

By John A. Lawson, F.R.E.S. (Published by Chapman and Hall, Ltd., London, Third Revised Edition, Illustrated, pp. 164, 8s. 6d.).

THIS handy little book is an excellent exposition of the most up-to-date modern methods of bee-keeping in England. The numerous illustrations, which are all very well-drawn, add to the utility of the book.

The book is a practical guide, very suitable for the beginner. It is full of practical hints and is written in clear, simple style.

Although much that is in the book will be inapplicable to Indian conditions because here we have a different bee, *Apis indica*, while this book deals with *Apis mellifica*, and also because of the difference of climatic conditions, etc., still we can recommend this book for study by beginners as much that it contains can be applied, with necessary modifications, to suit Indian conditions.—R.N.M.

ERRATUM

Indian Farming, Vol. VIII, No. 2, February 1947, page 90, 'Cotton Boll-worm Control by Genes': *for* 'V.G.P.' occurring in the last line within brackets *read* 'D.G.'

News and Views

MARKETING OF CATTLE IN INDIA

CATTLE play an important role in the rural economy of the country and their contribution to this economy is estimated to be Rs. 1,900 crores annually, says the Report on the Marketing of Cattle in India published by the Central Agricultural Marketing Department. It is emphasized, however, that although India holds a premier position as regards cattle population, she is neither the most densely cattle-populated country in the world nor has she a high ratio of cattle to human population. Her position in the international trade in cattle too is insignificant and her sea-borne trade of no consequence.

The Report gives useful statistical information regarding international trade in cattle, number of oxen and buffaloes in various parts of the country, mortality from contagious diseases among bovines, quinquennial export of cattle from India to foreign countries, average seasonal prices, trend of prices, number of cattle used for cultivating land, etc. Amongst the subjects discussed in the Report are the breeding of cattle on scientific lines, cooperative marketing of cattle, the movement of cattle in India and the salvaging of dry cattle. In view of the various contemplated agricultural development schemes and the activities of the Central and Provincial Governments in connection with livestock improvment and welfare and the efforts being made to improve indigenous cattle by means of scientific breeding, the information contained in the Report, it is pointed out, should prove very valuable.

As a result of indiscriminate breeding, Indian cattle are of inferior quality, says the Report. The majority of them do not possess characteristics of any one breed. Scientific breeding and rearing of cattle up to the age of puberty has a great bearing on the market value of animals. The number of Cooperative Cattle Breeding Societies and the number of cattle owned by the numbers of these Societies is very small in this country. In 1938-39 the number of cattle breeding farms in India was 53 and the Punjab was responsible for maintaining 57 per cent of the total cattle on these farms in British India. The Report recommends the desirability of organizing Cooperative Cattle Breeding Societies on a more extensive scale, particularly in the important cattle breeding tracts. To finance cattle breeding schemes, it is suggested that the possibility of levying a cess on slaughter, export of cattle and on the sale of cattle in shows and fairs in the various provinces and States should be explored.

The Report recommends the organization of Cooperative Cattle Marketing Societies throughout the breeding tracts of the country. The absence of such Societies obliges the producer to depend upon the money-lender and the broker to get him the maximum price for his cattle. Consequently, a considerable portion of the profit goes into the pocket of the middleman.

At present there are no organized agencies for the dissemination of market intelligence regarding the price, demand, supply, etc. of cattle in important markets. The Cattle Market News Service introduced in 1938 by the Central Agricultural Marketing Department does not serve the purpose sufficiently. It is emphasized, therefore, that Provincial and the State Governments should recognize its necessity and introduce a cattle market news service on an extensive scale suited to local conditions.

Due to economic reasons and lucrative prices offered in large towns many young cows and she-buffaloes are slaughtered when they go dry. In order to prevent the indiscriminate slaughter of such cattle, which would otherwise prove very useful for breeding purposes, the introduction of suitable legislation is recommended. It is further recommended that Cattle Salvage Stations should be established in big towns throughout India to take over such cows and she-buffaloes when they have been rejected by the city milkmen.

Lakhs of cattle die every year from contagious diseases in India and the total loss to the country on this account alone is estimated at over Rs. 3 crores. Besides the provision of more extensive legal sanctions for the control of bovine contagious diseases, the Report recommends the organization of Cooperative Cattle Insurance Societies on a sounder basis than hitherto attempted.

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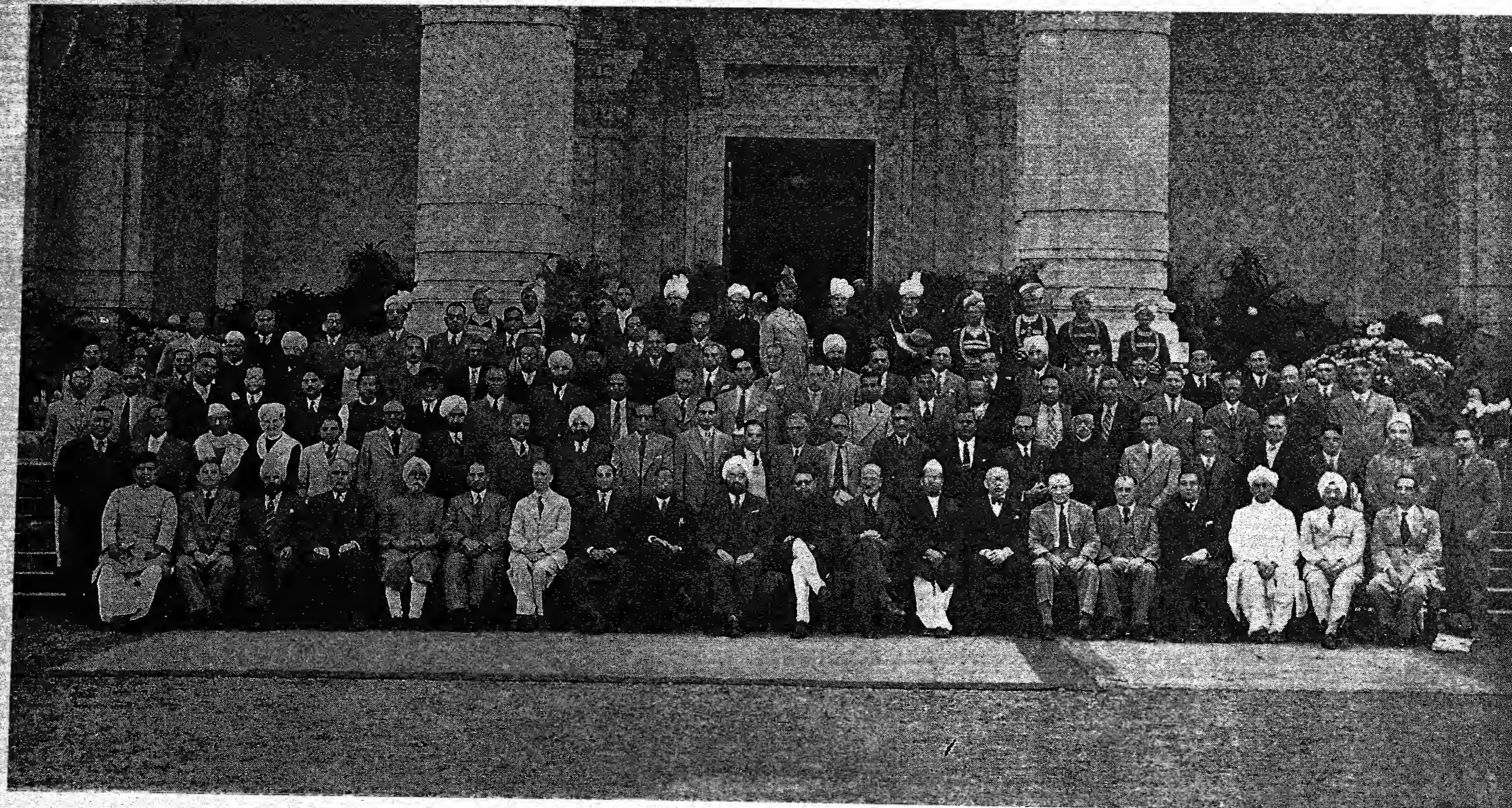


Plenary session of the Seventh Meeting of the Animal Husbandry Wing, Lucknow—19th and 20th December, 1946

PLATE 10

INDIAN FARMING

FEBRUARY, 1947

Vol. VIII No. 2

THE SEVENTH SESSION OF THE ANIMAL HUSBANDRY WING[1]

GENTLEMEN,

I am grateful to Sir Datar Singh and the Council for accepting the invitation I extended on behalf of the United Provinces to the Council to hold the Seventh Session of its Animal Husbandry Wing in Lucknow this year and on behalf of the United Provinces and myself, I accord to you all a very cordial welcome. This is the second occasion for the United Provinces to welcome the Animal Husbandry Wing of the Council, the first being at Izatnagar in 1940. Since then the world has undergone the travails of the second world war. The country has gone through hard times. In all provinces popular ministries are now at the helm of affairs, but our troubles have not yet ended. On the contrary, the war has brought in its wake many problems the chief of which, as you are doubtless aware, is the world-wide scarcity of food. It is now our responsibility to find a lasting solution for the food problem. Though India is predominantly an agricultural country it is sad to admit that the vast proportion of the people have been the victim of perpetual malnutrition. It is true that we have received some help from other countries in meeting our food supplies yet we cannot forget that this is a problem which we alone can solve. The Imperial Council of Agricultural Research has been playing a most useful part in developing agriculture and animal husbandry in the country. The Council is not only, if I may be permitted to say so, a parliament of agricultural and veterinary experts, but is also the only forum where officers and scientists engaged in administering these nation-building departments can foregather to exchange notes. The Council has been doing most useful work in initiating and guiding research in most of the problems which confront the agriculturist in this country.

It is needless to say that in a predominantly agricultural country like ours, animal husbandry is of the utmost importance. The quality and number of plough cattle are the limiting factors in any scheme of development of agriculture. We are still far away from the age of mechanized agriculture and for a considerable time to come our cultivators will have to depend on bullock power. Animal husbandry, therefore, by trying to develop cattle not only helps to grow more cereals but also assists in directly growing more protective food like milk, milk products, poultry and fish which are essential supplements to the normal cereal diet on which the majority of the people subsist. The number of milch cattle in the country is reported to be very large, but the unfortunate fact is that many of these are useless and in fact it is the poor cattle which practically live at the expense of the superior cattle. Our milk and milk products lag far behind other countries of the world with lesser cattle population. This is one of the most serious problems which demands a solution.

The United Provinces can legitimately feel proud that it was almost the first province in India to establish a full-fledged department of animal husbandry in which all the various activities like the care, treatment and breeding of cattle, goats and sheep, poultry and fisheries,

[1] Inaugural address delivered by the Hon'ble NISAR AHMED SHERWANI, Minister of Agriculture, the United Provinces, on Thursday, December 19, 1946.

have been coordinated under one department. It is true that the department was born under the stress of war conditions but the activities started then are being extended and consolidated and it is hoped that before long it will be placed on a permanent footing and will prove itself of the utmost benefit to the people in this province.

Livestock development has a long history in the United Provinces, going, if I may say so, to pre-historic times; but the United Provinces is a big province and as in many things, its problems are varied and many. It is naturally to be expected that for a province of this size with different climatic conditions, it has not been found possible to evolve a breed which could be found of uniform utility in all the parts of the province. We are, however, shortly establishing a full-fledged livestock research station, whose responsibility it would be to study various problems relating to livestock, disease control, nutrition, research, dairying and cattle breeding. We are also intending to establish dairy demonstration farms on up-to-date lines in various places. It is hoped that these demonstration farms will serve as nuclei for general cattle development in their neighbourhood. We also propose to establish a veterinary college the plans for which are nearly complete and it is hoped that the college will start functioning from July next. Our target is to provide at least one qualified veterinary doctor for every 25,000 heads of cattle and a stockman for every 6,000. The lack of trained personnel, however, is a limiting factor. Hitherto we were compelled to send our boys outside the province for training in veterinary but the time has now arrived, if the science of animal husbandry is to receive the attention it deserves, that we must have an up-to-date college in the province itself.

In poultry, the United Provinces has taken a prominent place in the country and has during the war supplied vast quantities of eggs and poultry to the armed forces. These supplies are the result of the improvement in poultry breeding. The organization though set up during the war is being switched over now to meet the requirements of the civilian population. Poultry breeding, besides providing the much needed protective foods for people who can take them, is calculated to bring additional income to the pockets of the poor villagers. To encourage this industry still further we have established 16 poultry farms spread all over the province and this number is likely to increase in the near future. I should not omit here to mention the fisheries section of the department of the animal husbandry. Fisheries are a valuable asset and our efforts in the past encourage us to extend its activities further and before long it is hoped that fishery will have a full-fledged department of its own. We are also undertaking necessary legislation to give effect to our various activities connected with animal husbandry, as for example, we propose to have a Veterinary Council Act, a Contagious Diseases Act, a Fisheries Act and a Livestock and Livestock Products Act. We have also established a biological products laboratory, where I am told that, for the first time in India, the manufacture of desiccated serum in pill form has been successfully undertaken.

Gentlemen, I regret I have taken so much of your time in talking about my own province, but that was perhaps only natural. The country owes a debt of gratitude to the Council and the Animal Husbandry Wing and to the scientific and administrative officers of the provinces and the States, who have striven to bring to the service of their country the results of their ripe experience in solving the complicated and difficult problems connected with animal husbandry.

I see on your agenda an item of discussion regarding the place of *panchayatghars* in rural economy in general and in coordinating the activities of the animal husbandry in particular. It has always been our aim, to establish as many *panchayatghars* as possible and I believe they can serve as the centres of all rural development activities in the village. We are also considering how best to coordinate all the work of the various nation-building departments in the province and we soon hope to have a development board for the province, with its branches in each district.

Your meeting in the historic city of Lucknow gives great pleasure to us all and I hope you will see for yourself some of the animal husbandry activities in progress in this province in the course of the excursions which my department has arranged for you. I wish your conference success. And now I have great pleasure in declaring this, the Seventh Session of the Animal Husbandry Wing of the Imperial Council of Agricultural Research open, and with your permission I must leave you to your deliberations.

Original Articles

THE MONSOON OF 1946

THIS year's monsoon gave fairly well-distributed rainfall over the country, the amount for the season, averaged over the plains of India, being in excess by 4 per cent.

The Arabian Sea monsoon established itself over the west coast of the Peninsula by 5 June, and thereafter prevailed with more or less constant strength with occasional pulses of increased activity. The Bay current fell short of its normal activity in the beginning. Its advance was slow and north-east India came under its full sway only by about 22 June. Later, however, stimulated by the depressions from the head Bay, it succeeded in giving nearly normal rains over its field of activity.

The most noteworthy floods during the season occurred in and around Chittagong district in the second week of July, while isolated very heavy showers fell in the north Konkan and east Gujrat during the period 8 to 11 September.

March of the season

June: The monsoon set in over Malabar on 28 May without, however, the occurrence of heavy rain there. A fresh pulse of the monsoon arriving on 2 June gave rise to a cyclonic storm, which served to usher in the monsoon up the entire west coast of the Peninsula. During the first half of the month, the activity of the Arabian Sea monsoon was confined to Malabar and the Konkan while fairly widespread thundershowers occurred over the region from the Bombay-Deccan to Assam. The monsoon extended into Gujrat on 18, and for the next three days locally very heavy rain fell in south Kathiawar and east Gujrat, resulting in floods and consequent damage to property. Press reports, however, indicate that the torrential rains had done good to the paddy seedlings and helped the transplanting work.

Contributed by the India Meteorological Department, Poona.

The Bay branch of the monsoon, though reaching east Bengal and Assam by 9 June, remained weak until 21. Thereafter it extended westwards and by 23 established over north-east India and east United Provinces. Meanwhile, the Arabian Sea branch had also advanced over the central parts of the country and east Rajputana. The last week of the month was, therefore, a period of good rains generally over the country except for the western divisions of north-west India; regarding the latter region, thundershowers occurred at many places in the Punjab, west Rajputana and lower Sind only on the last three days of the month.

Averaged over the plains of India, the month's rainfall was 16 per cent in excess.

July: The monsoon was fairly active over the country outside north-west India during the first week of the month.

A break in the monsoon over the central parts of the country set in by 8 and persisted till 13; during this period, widespread and locally heavy rain fell in Assam, north Bengal, Bihar, the United Provinces and Malabar. Heavy rains in the eastern Himalayas and Khasi Hills, draining through the valleys of Assam and east Bengal, caused extensive floods in east Bengal, especially in and around Chittagong district. According to press reports nearly 50,000 families were rendered homeless and many villages were inundated by the overflowing waters of the Brahmaputra, the Barak and the Karnaphuli. Traffic and communications were seriously affected. Considerable destruction of the *aus* crop and heavy loss of *sali* paddy seedlings occurred beside damage to standing rice crops.

The latter half of the month was marked by the revival of the activity of the monsoon over west coast of the peninsula and its extension up to Sind, and the formation of two depressions in the north Bay and their movement inland. In association with these depressions, wide-

spread rain fell in Central Provinces and adjoining Central India from 20 to 30, in Orissa and the north Madras coast on 25 and 26, and in south-east Rajputana, Gujrat, the United Provinces, the Bombay-Deccan and Hyderabad from 27 to 31.

Averaged over the plains of India, the month's rainfall was in defect by 10 per cent.

August: The Arabian Sea monsoon remained generally active over Malabar, the Konkan and Gujrat during the month, and gave frequent spells of heavy rains. The month was also marked by the movement westwards of four depressions from the Bay and one land depression from Bengal. The passage of these depressions, across the country in quick succession served to maintain the monsoon almost uninterrupted over the tract from the Bombay-Deccan and Rajputana to Bengal and Assam till about 25.

Thereafter, the monsoon weakened over north-east India and the central parts of the country. However, there was again a strengthening on 30 and widespread rain fell in north-east India outside Assam on the last two days of the month, while rainfall again extended into the east United Provinces on 31.

Averaged over the plains of India, the month's rainfall was 17 per cent in excess.

September: The month began with an active monsoon over north-east India and in the west coast of the Peninsula, while locally heavy rain recurred in the submontane districts of the east United Provinces during the first five days of the month.

During the month, three depressions were formed in the Bay of Bengal. The first two travelled westwards across the country up to Rajputana while the third moved over to Bihar and broke up against the eastern Himalayas. Widespread and locally heavy rains occurred in the central parts of the country and in north-east India in association with the movement of these depressions during different periods in the month. Very heavy rain fell in the north Konkan and east Gujrat during the period 8 to 11. Bombay had a downpour of 8·6 in. of rain on the night of 8 September; many low-lying areas of the city were submerged and traffic and communications were seriously interrupted. Consequent to the formation and movement of the last depression of the month, widespread and generally heavy thundershowers occurred in north-east India during the period 15 to 19. A total of 10·6 in. of rain was recorded by Calcutta between the morning of 15 September and the evening of 16 September, flooding considerable areas of the town. According to press reports, several breaches occurred in the East Indian Railway lines between Gaya and Patna due to the heavy rains, while several villages were inundated and standing crops damaged in many districts in Bihar, south-west Bengal and the east United Provinces.

The Bay monsoon began to withdraw from north-east India on 20 September. At about the same time the Arabian Sea branch also withdrew from its field of activity. For the rest of the month generally local showers occurred in the eastern half of north-east India and in the south Peninsula.

Averaged over the plains of India, the month's rainfall was in defect by 24 per cent.

TABLE I

Progress of monsoon week by week, 1946

SUB-DIVISION	WEEK ENDING 5–6–46	12–6–46	19–6–46	26–6–46	3–7–46	10–7–46	17–7–46	24–7–46	31–7–46	7–8–46	14–8–46	21–8–46	28–8–46	4–9–46	11–9–46	18–9–46	25–9–46	2–10–46
1. Bay Islands ..	1·0	**1·7**	1·2	*0·3*	0·6	*0·4*	*0·4*	0·7	*0·2*	0·5	1·4	1·3	0·9	1·3	**3·0**	*0·1*	*0·3*	1·1
2. Assam ..	0·7	**1·6**	1·2	0·7	0·8	**1·9**	*0·4*	0·8	0·6	†	1·1	0·7	0·7	1·2	*0·3*	0·9	0·9	*0·3*
2(a). Upper Assam ..	0·7	**1·8**	1·5	0·7	0·9	**2·1**	*0·3*	0·9	0·8	†	1·1	0·7	*0·4*	**1·6**	*0·2*	1·0	1·0	*0·4*
2(b). Lower Assam ..	0·5	1·1	0·6	0·7	0·8	1·3	0·6	0·7	*0·4*	*0·3*	0·8	0·7	1·1	0·6	0·5	0·8	0·5	*0*
3. Bengal ..	0·6	1·5	1·0	1·0	0·5	**1·6**	**1·6**	*0·4*	0·9	1·0	1·3	1·1	0·6	**2·2**	0·9	1·2	0·6	*0·4*
3(a). Bengal, North ..	0·6	1·4	1·4	0·7	*0·2*	**1·7**	1·3	0·5	0·9	*0·3*	1·2	0·6	*0·3*	**1·8**	0·5	0·5	1·0	0·7
3(b). Bengal, South-east.	*0·4*	**1·6**	0·8	1·5	*0·2*	**2·1**	**1·8**	*0·4*	1·0	1·5	**1·6**	1·2	0·7	**2·3**	0·6	0·7	0·6	*0·2*
3(c) Bengal, South-west.	0·7	1·4	0·9	0·8	1·2	0·9	**1·6**	*0·3*	0·7	1·0	1·1	1·3	0·6	**2·5**	1·5	**2·6**	*0·2*	*0·4*
4. Orissa ..	0·9	0·8	1·4	1·2	1·4	*0·4*	1·0	1·3	1·1	**1·8**	*0·3*	1·3	1·4	1·0	1·2	**1·8**	*0*	**1·9**
5. Chota Nagpur ..	**2·0**	1·2	0·7	**1·9**	1·5	0·7	2·1	*0·3*	**1·6**	1·2	0·7	0·9	1·1	1·1	*0·4*	0·9	*0·2*	1·0
6. Bihar ..	1·2	**1·8**	0·6	1·0	1·4	**1·7**	**1·6**	0·6	0·6	0·6	0·9	0·6	*0·4*	**2·0**	0·5	0·5	*0·4*	0·5
7. U. P., East ..	0·7	1·0	*0·4*	0·6	1·2	1·3	**1·8**	*0·4*	0·6	0·7	0·9	0·7	0·6	1·4	*0·1*	0·9	0·9	*0·2*
8. U. P., West ..	1·0	0·7	0·9	0·9	1·1	**1·7**	0·7	1·3	**1·9**	0·8	0·9	0·8	0·9	*0·2*	*0·1*	1·4	*0·1*	*0·1*
9. Punjab, E. and N. ..	1·0	**2.0**	**2·0**	0·8	**2·1**	0·8	0·9	0·5	**1·9**	**2·1**	0·8	0·7	1·1	1·1	*0·2*	*0·4*	*0*	*0*
10. Punjab, South-west ..	**2·0**	1·0	*0*	*0*	1·0	*0·1*	0·6	*0*	0·9	0·8	*0*	*0·3*	*0·2*	*0*	*0*	*0*	*0*	*0*
11. Kashmir ...	*0·3*	**1·7**	1·5	*0*	**2·3**	*0*	*0·4*	0·7	0·7	**2·3**	*0·3*	*0·2*	0·5	*0·3*	0·5	*0·2*	*0*	*0*
12. N. W. F. P. ..	*0*	*0*	1·0	*0*	*0*	*0*	*0·2*	*0*	*0*	*0·2*	*0*	*0*	1·5	*0*	0·5	*0*	*0*	*0*
13. Baluchistan ..	**2·3**	*0*	*0*	*0*	*0*	*0*	*0*	*0·3*	*0·3*	1·0	**1·7**	1·0	1·0	1·0	*0*	*0*	*0*	*0*
14. Sind ..	*0*	*0*	*0*	*0*	**2·2**	*0*	*0*	0·7	0·5	**2·7**	0·2	1·3	**2·5**	*0*	*0*	*0*	*0*	*0*
15. Rajputana, West ..	*0*	*0*	*0*	1·3	**3·6**	*0*	*0*	1·0	0·6	0·5	**1·6**	1·5	**1·8**	*0·1*	0·5	*0*	*0*	*0*
16. Rajputana, East ..	0·5	**2·5**	1·3	**2·2**	**2·5**	*0·4*	*0*	0·7	**2·5**	0·7	**3·7**	**2·4**	**2·5**	*0·1*	*0·1*	**4·6**	*0*	0·5
17. Gujarat ..	*0*	0·7	*0·4*	**2·4**	1·5	0·5	*0*	1·3	1·3	**2·2**	1·1	**3·2**	**2·2**	*0·4*	**2·0**	*0·3*	*0·2*	*0*
18. C. I., West ..	*0*	1·3	**2·1**	**1·7**	**2·0**	**2·2**	*0*	0·6	**2·3**	**2·0**	**2·0**	**2·4**	1·3	*0·1*	*0·4*	**2·1**	*0*	*0·1*
19. C. I., East ..	**4·0**	**5·5**	*0·4*	1·5	1·0	1·3	1·3	*0·2*	**1·8**	**1·8**	1·3	1·0	0·7	*0·1*	*0·1*	**1·8**	*0*	*0·3*
20. Berar ..	0·8	**3·0**	0·6	*0·3*	*0·2*	**2·5**	*0*	**1·7**	**3·4**	1·5	1·2	1·0	*0·1*	*0·2*	**3·1**	*0*	*0·1*	*0·1*
21. C. P., West ..	1·5	**2·6**	**2·0**	**1·6**	0·9	1·0	*0·1*	1·1	**1·8**	**1·8**	1·3	**1·9**	1·2	*0·1*	*0·4*	0·8	*0*	*0·3*
22. C. P., East ..	0·7	0·7	0·7	**1·7**	0·6	0·8	*0·2*	1·4	**1·8**	**2·2**	0·6	1·2	1·0	0·5	1·2	0·8	*0·2*	*0·2*
23. Konkan ..	**1·9**	**2·2**	1·3	0·6	*0·3*	0·6	*0·1*	1·2	0·7	1·0	1·2	1·2	0·8	0·5	**3·0**	0·6	*0·2*	*0·4*
24. Bombay-Deccan ..	**2·0**	0·8	0·8	0·8	*0·4*	0·9	*0·1*	0·8	**3·2**	**1·7**	**1·8**	1·0	0·8	*0·2*	**2·5**	*0*	0·9	0·9
25. Hyderabad, North ..	0·7	**2·5**	1·2	0·5	*0·4*	1·5	*0·1*	1·2	**1·9**	0·5	**1·9**	**1·7**	*0·2*	*0·1*	**1·6**	*0·2*	*0*	**1·6**
26. Hyderabad, South ..	1·0	**3·2**	**1·6**	0·6	*0·2*	1·2	*0*	**2·2**	1·3	0·8	**1·9**	0·7	*0·2*	*0·3*	0·5	*0·1*	*0·2*	1·1
27. Mysore ..	0·6	*0·1*	0·5	1·3	1·0	**2·4**	*0·3*	**1·7**	*0·3*	1·0	**3·4**	1·1	*0·2*	1·0	1·1	*0·3*	1·1	1·4
28. Malabar ..	1·1	0·7	1·3	**1·7**	**1·6**	1·1	0·9	1·4	*0·3*	**2·0**	**1·8**	**1·7**	**2·7**	1·0	1·1	*0·4*	*0·2*	**1·6**
29. Madras, South-east ..	*0·3*	0·7	**1·7**	1·0	0·7	0·7	1·4	*0·4*	*0·4*	0·7	1·4	0·9	*0·4*	**1·7**	**2·4**	*0·1*	0·9	1·0
30. Madras-Deccan ..	*0·4*	1·0	**1·7**	*0*	*0·2*	*0·1*	*0·3*	**1·9**	*0·4*	1·0	1·3	*0·1*	*0·3*	0·8	0·5	*0*	*0·3*	**2·3**
31. Madras Coast, N. ..	*0·2*	0·9	1·0	*0·3*	*0·1*	1·1	*0·3*	**2·7**	**1·6**	**2·0**	1·4	1·2	*0·3*	*0·4*	*0·4*	*0·3*	*0·2*	1·0

The figures in the Table represent the ratios of the actual rainfall to the normal rainfall. For example, in the week ending 5-6-46, the figure 1·2 printed against Bihar, means that in that division, the actual rainfall during the week was 1·2 times the normal.

Figures in thick type indicate large excess, i.e. over 50 per cent above the normal, and figures in italics, large defect, i.e. over 50 per cent below the normal.

† Observations not recorded.

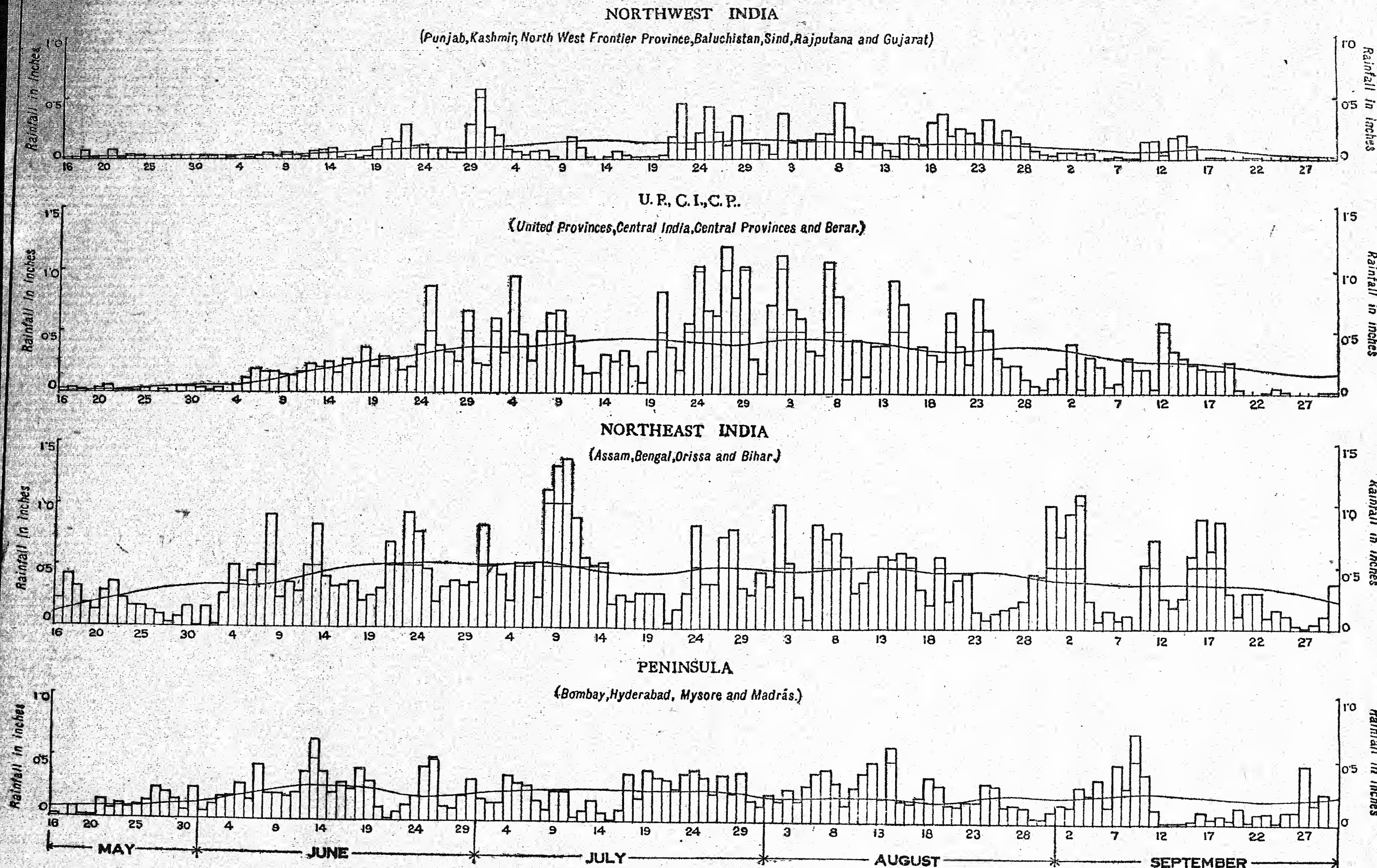


FIG. 1. Progress of the monsoon day by day (16 May to 30 September 1946). The stepped curves represent the actual rainfall and the continuous ones the normal rainfall.

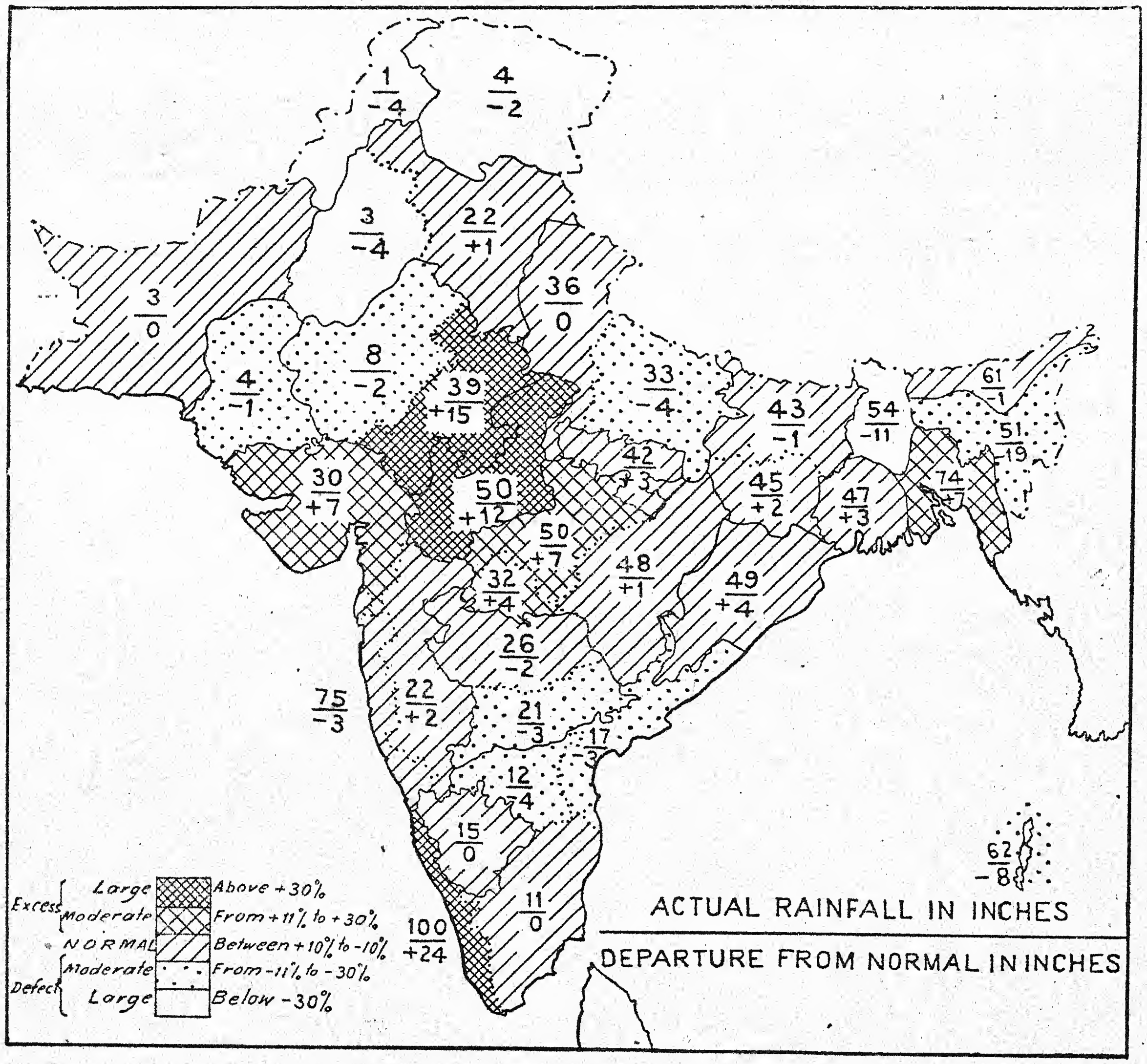
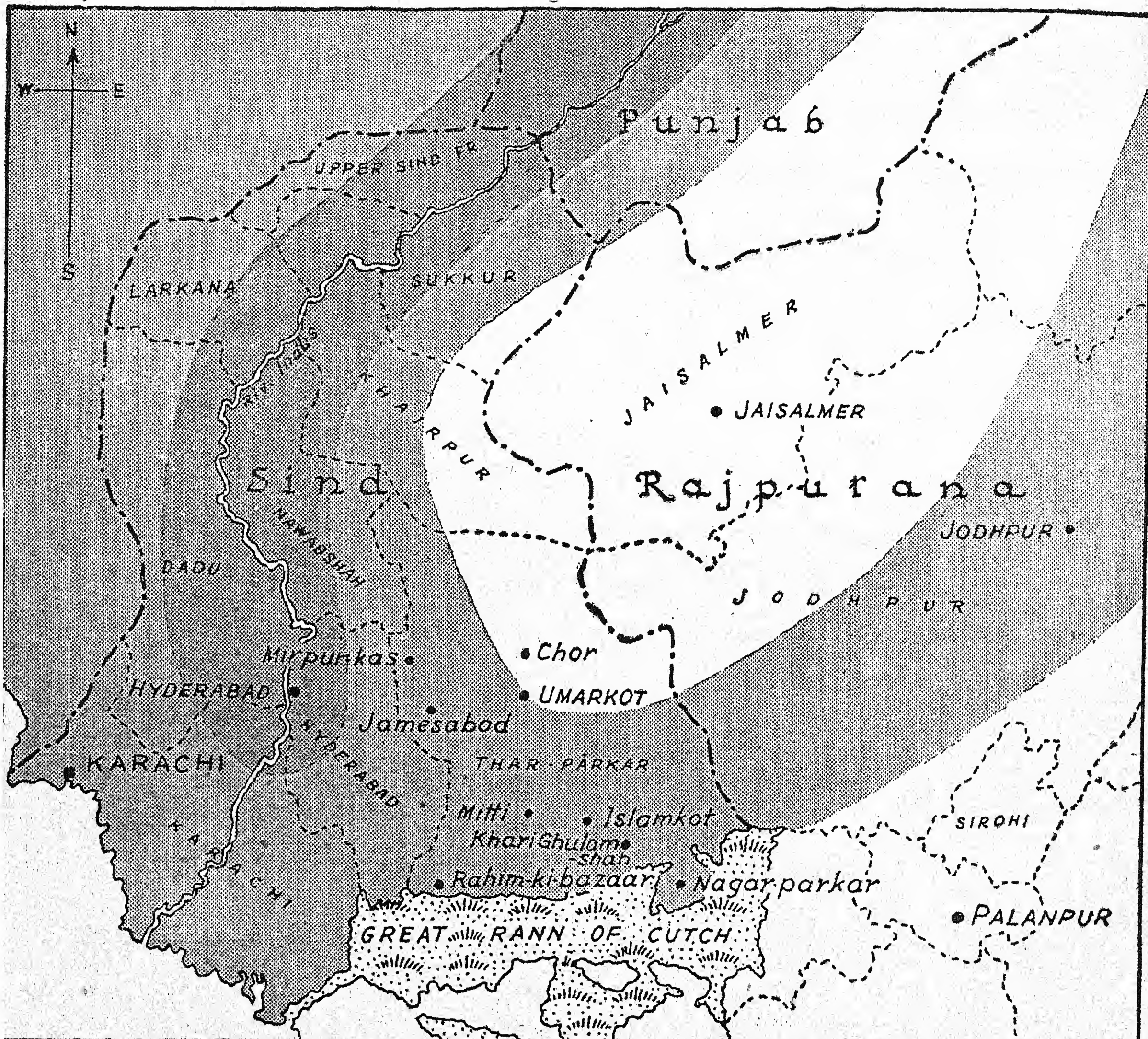


FIG. 2. Showing actual rainfall—June to September, 1946.


N
W
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NAWABSHAH
DADU
Chor
Mirpurkas
HYDERABAD
UMARKOT
Jamesabod
HYDERABAD
KARACHI
THAR - PARKAR
KARACHI
Mitti
Islamkot
KhariGhulam-shah
SIROHI
Rahim-ki-bazaar
Nagarparkar
PALANPUR
GREAT RANN OF CUTCH

PLATE 11

THE THARPARKAR OR THARI BREED OF CATTLE

DEFINITION OF CHARACTERISTICS

By GRAHAME WILLIAMSON

IN response to the recommendation made by the Livestock Committee at its meeting in November 1945, I visited the Tharparkar district between October 22 and November 2, 1946, to attempt to reconcile the divergent views expressed by three committees which had examined and made recommendations concerning the characteristics of the Thari or Tharparkar cattle. To do this, it was necessary that I should have first-hand information of the subject, should be uninfluenced during my tour by any supporter of either contention and should be free to examine any herds I desired. These conditions were fulfilled.

I travelled from rail-head at Naukot to within 34 miles of Nagar Parkar *via* Mithi, Islamkot and Khari Ghulam Shah, returned to Jamesabad and then went *via* Hyderabad to Rahim ki Bazar, but was unable to reach Nagar Parkar as the road was blocked by flooding.

I was accompanied by Dr L. M. Hira, Marketing Officer, Sind, and Mr Pherwani. The latter gentleman had been Secretary and member of the last committee, but cattle were not inspected in his presence nor were his views on the subject under consideration obtained until the completion of the tour.

The object of study

The last committee came to the conclusion that, apart from measurement of height and length, there was no significant difference between the descriptions offered by the previous committees, and the opinion was expressed that these differences in height and length were not fundamental but arose as a result of environment. It was in deference to this opinion and in the realization of the undesirability of multiplying the number of recognized breeds unnecessarily that I was asked to study the subject in the belief that it might be possible to reconcile the opinion of the authorities on the subject and to open a common register for the breed.

GRAHAME WILLIAMSON, O.B.E., M.R.C.V.S., D.V.S.M., is Animal Husbandry Commissioner with the Government of India.

A study of the comparison of the two types as published under the direction of the Advisory Board by Ware in *Indian Farming*, Vol. II, No. 12, December 1941, shows that there is a difference of opinion on the following points:

(1) Designation
(2) Habitat
(3) Conformation
  (a) Horns
  (b) Forehead
  (c) Face
  (d) Colour
(4) Size

(1) *Designation:* The breed is invariably designated Thari throughout the whole Tharparkar district, throughout Sind and, it is believed, in the bordering States. On the other hand, the term Tharparkar cattle is accepted by every one in the district as being a rather quaint but recognizable synonym of Thari cattle. The term is unusual but causes no confusion locally; it is now the better-known term throughout India and abroad, and there is, therefore, no real objection to its use.

The objection to it arose from the fact that it was associated with the Karnal Farm type of cattle and the Sind breeders will not sustain their objection to its use provided it is authoritatively accepted that the type of Tharparkar is as described below.

(2) *Habitat:* In the tract traversed by me the influence of the Red Sindhi on the herds was obvious up to Mithi from where it waned, but could be detected right through to Khari Ghulam Shah: the Gir influence was also obvious (Plate 12, figs. 1-3). On the other hand, as soon as Mithi was passed, the Kankrej, or, as it is locally called, Wadhiyari influence becomes apparent and grows in intensity the further one proceeds south (Plate 13, figs. 4-5). At Khari Ghulam Shah a very great proportion of a herd of over 1,000 head bore traces of Kankrej blood (Plate 13, fig. 6), and in a herd north-west of Lantur one of the two bulls might well have been a pure-bred Kankrej.

I consider, therefore, that it may be taken as a fact that 'the breed is found in greatest

purity in the vicinity of Amarkot, Naukot, Dhoro Naro and Chor'.

(3) *Conformation:* (a) *Horns.* It is very rarely that one sees an animal with horns which are not curved inwards. By far the commonest was the semi-short, rather blunt horns growing from a moderately pronounced base in an open-crescent direction. It is, therefore, considered that the horns may be described thus:

'Set well apart curving gradually upwards and outwards in the same line as that of the pole, with blunt points inclined inwards; moderately thick at the base, that is, from 5 in. to 7 in. in circumference just above the skin in cows, and tapering gradually, being about 7 in. to 9 in. long as measured in the inner curve. In the male, the horns are thicker, shorter and straighter than in the female. Horns much thicker at the base or much longer are not acceptable'.

(b) *Forehead.* A pronounced convex forehead indicates Gir blood. The description of this feature should thus be:

'Broad and flat or slightly convex above the eyes. The front of the horns and face are practically in one plane; in bulls the convexity may be slightly more pronounced. A boldly convex forehead is not acceptable'.

(c) *Face.* 'Lean and fine, slightly dished to the muzzle, which with the nostrils are broad and black; lips are muscular and jaws strong'.

(d) *Colour.* 'The hair is white or grey; in some animals it approaches black with a light grey stripe along the backbone. The face and extremities are of a darker shade than that of the body. Red is not acceptable.'

(4) *Size*: It is desirable to eliminate extremes of size, and it is thus possible to indicate the limits within which both the so-called types may be included. It is suggested that they be defined as in the Appendix.

With these adjustments, the description as given in the Appendix may be accepted as the official one (the words used by the Committees have been retained as far as possible). I was able to discuss it with Mr Mir of Mirpur Khas and Mr Pherwani, two members of the last committee, and to obtain their approval of it.

Additional observations

It appears to me to be doubtful if a well-defined homogeneous breed, such as one finds in the Hariana, Malvi, Red Sindhi, etc. tracts, ever existed, and it certainly does not exist today. It is said that the present state is accounted for by the fact that in the bad years of 1938 and 1939, such of the cattle as did not leave the district died of starvation and that the emigrant cattle returned much reduced in numbers and accompanied by those of neighbouring breeds, or with progeny of bulls of these breeds. It must be admitted, however, that the famines of 1938 and 1939 were incidents which have recurred in a similar form periodically throughout the centuries, and what happened then to cause divergence in characteristics must have happened repeatedly to the breed, for the conditions in the desert of Thar are the same now as have existed since time immemorial. When there is a good year and grass is plentiful, cattle are sent in from the surrounding Sindhi, Kankrej and Nagori country, while in the periods of severe scarcity or famine, the population of the district emigrates to the surrounding richer areas. The direction of the periodic emigration of the population is governed by the availability of work for the people as well as subsistence for the cattle, and it is well to remember that although most of the bullocks go south to Gujrat for sale, there is no corresponding trade movement from Gujrat north-west. Probably over 75 per cent of the Thari breeders always move westwards, northwards, or eastwards, and only a few move south to the Kankrej country. The influence of the Kankrej blood, however, has been accentuated by the fact that breeders over the greater part of the Thar desert have favoured Kankrej bulls as they have given size and agility to the stock and improved the value of the bullocks. This practice may have become more popular in recent times, but an elderly, experienced, very large cattle-owner asserted that his great-grandfather had followed the practice at Khari Ghulam Shah.

It is not to be wondered at, therefore, that a variation exists in the type in every herd; to the west the Sindhi influence is obvious, to the east and south that of the Kankrej, and to the north and east, the effect of the Nagori blood is evident.

The Thari owner's main objective is *ghee.* He has, therefore, sought for deep milkers wherever they could be obtained, provided always that the cows are good foragers and can withstand the rigorous conditions of life inseparable from the Tharparkar grazing district. It is thus possible when buying stock

Fig. 1. A common type of head seen in the cattle at Mithi denoting Gir blood.

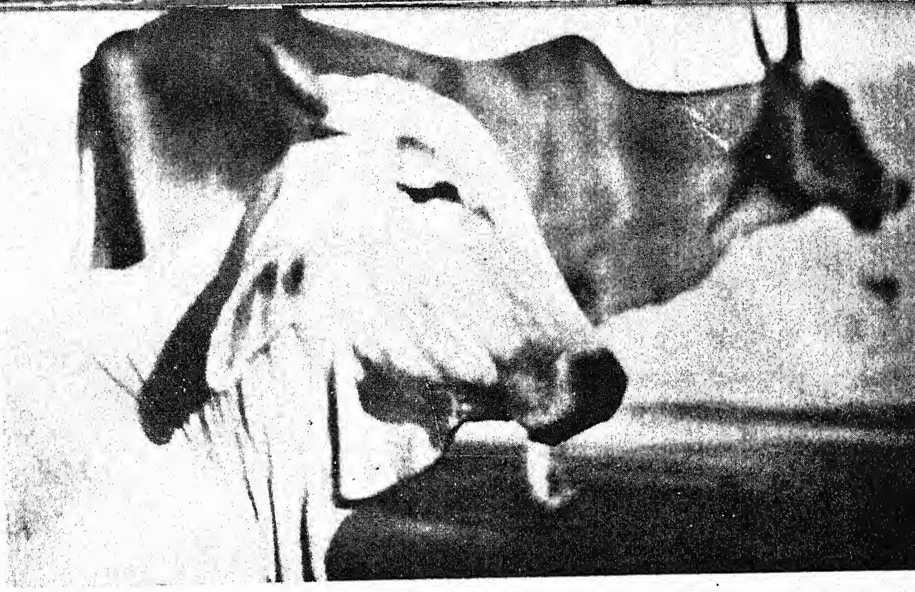


Fig. 2. The head of a red roan cow at Islamkote.

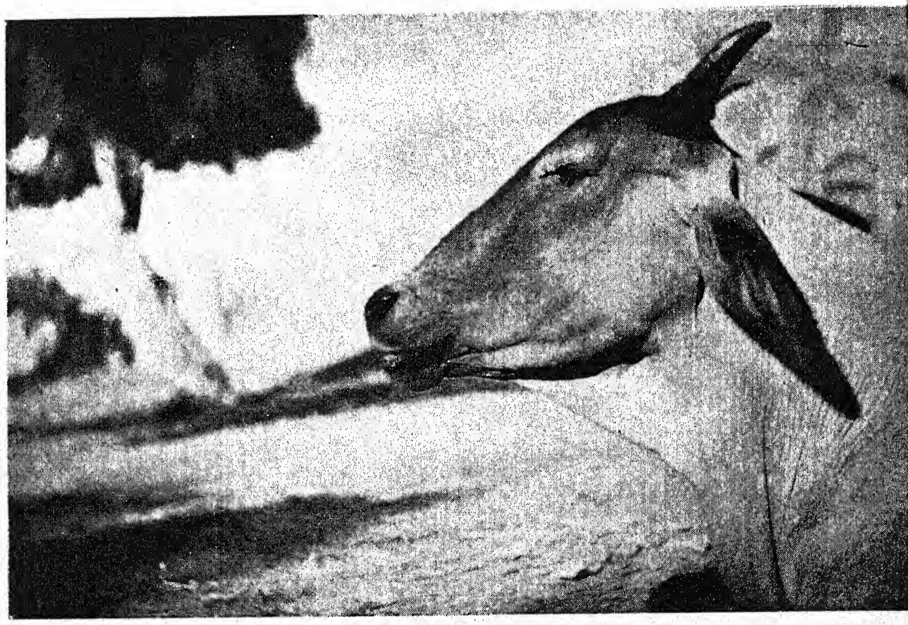
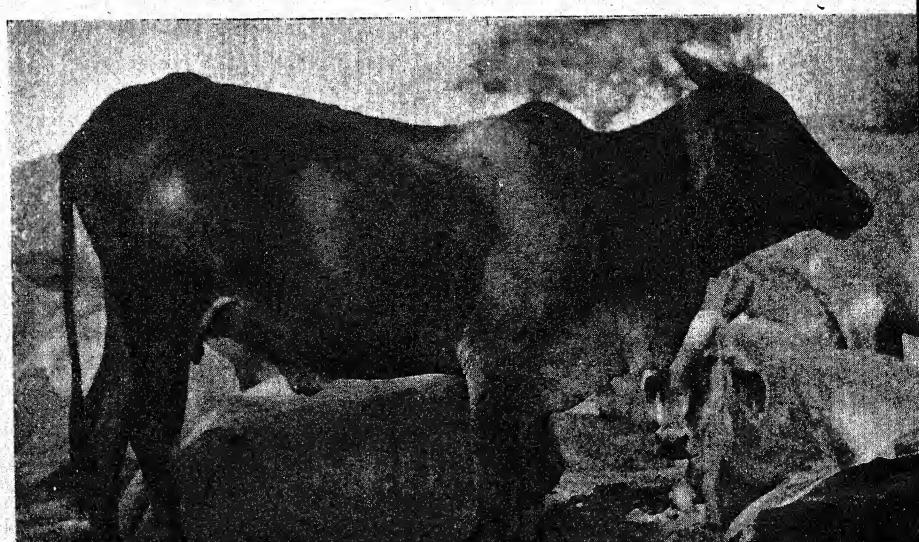


Fig. 3. This cow at Mithi was one of many red-coloured ones.



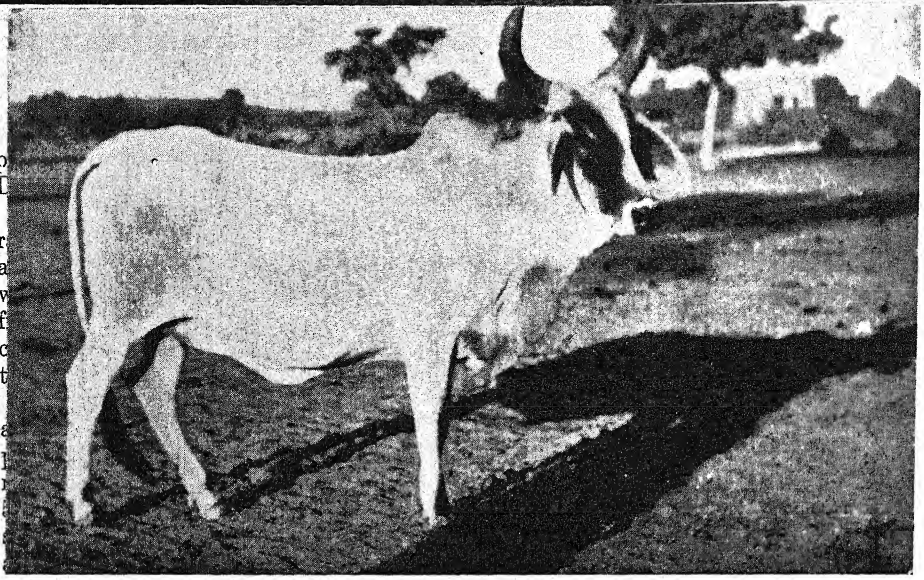


FIG. 4. Illustrating the Wadhiyari or Kankrej influence.

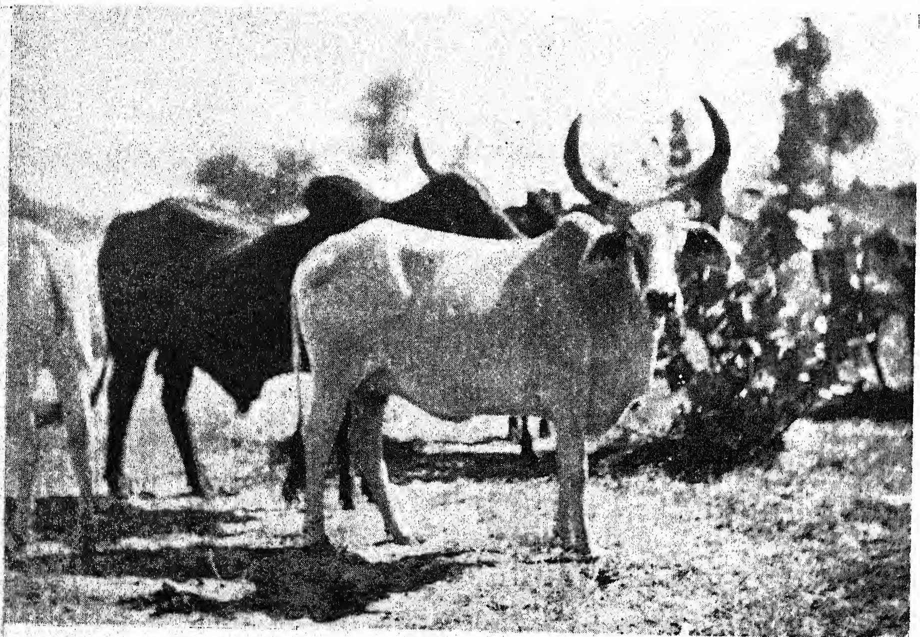


FIG. 5. Illustrating the Wadhiyari or Kankrej influence.

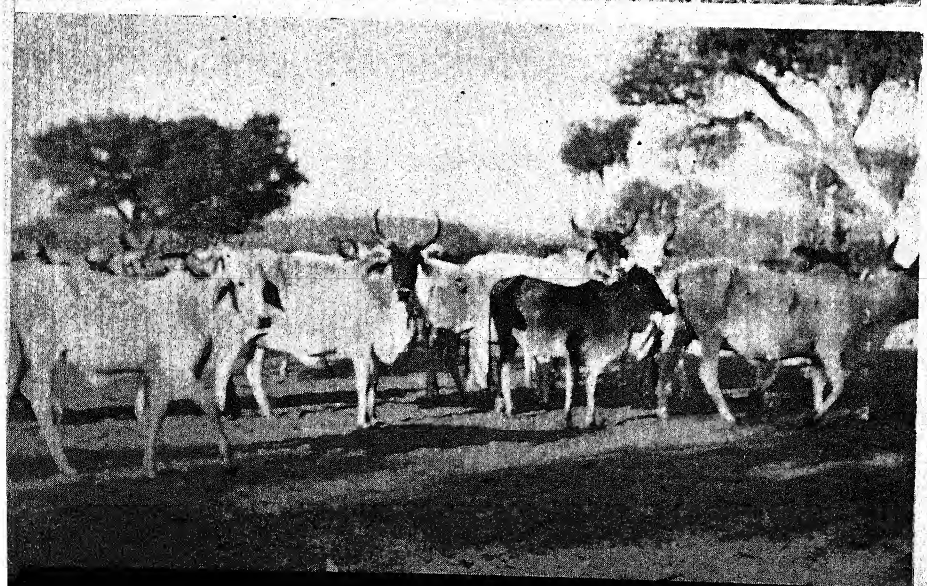


FIG. 6. Part of the herd at Khari Ghulam Shah.

PLATE 13

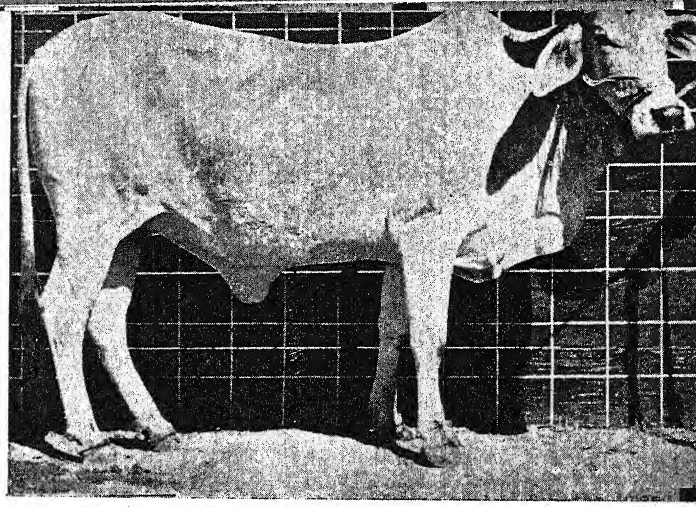


FIG. 7. Heifer: Owner, Khasi Noor Mohd. of Tharparkar district.

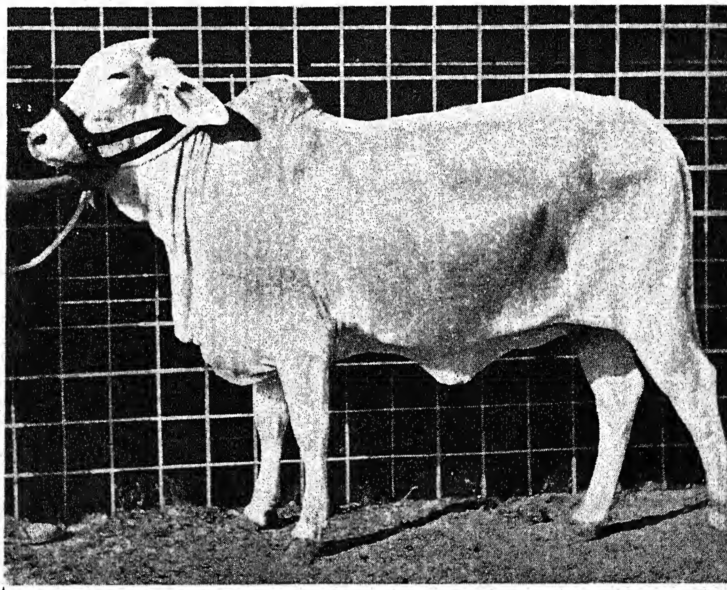


FIG. 8. Heifer: Karnal herd of Imperial Agricultural Research Institute.

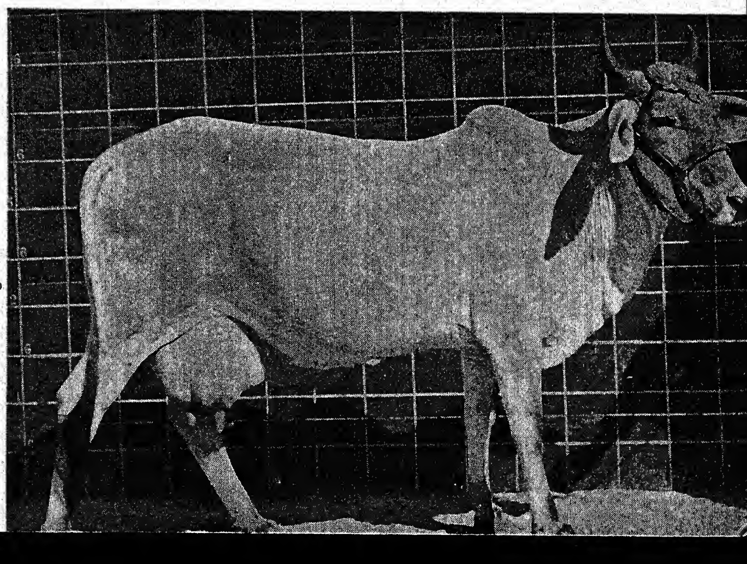


FIG. 9. Cow: Government Cattle Farm, Sind.

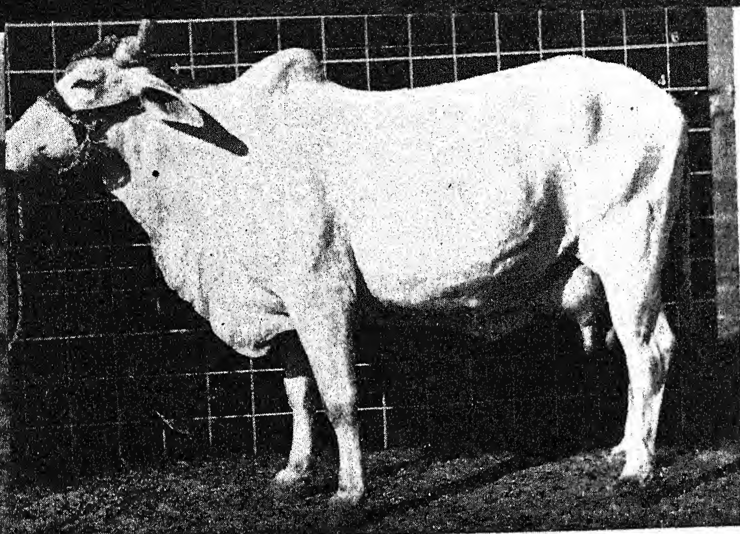


Fig. 10. Cow : Government Cattle Farm, Patna, Bihar.

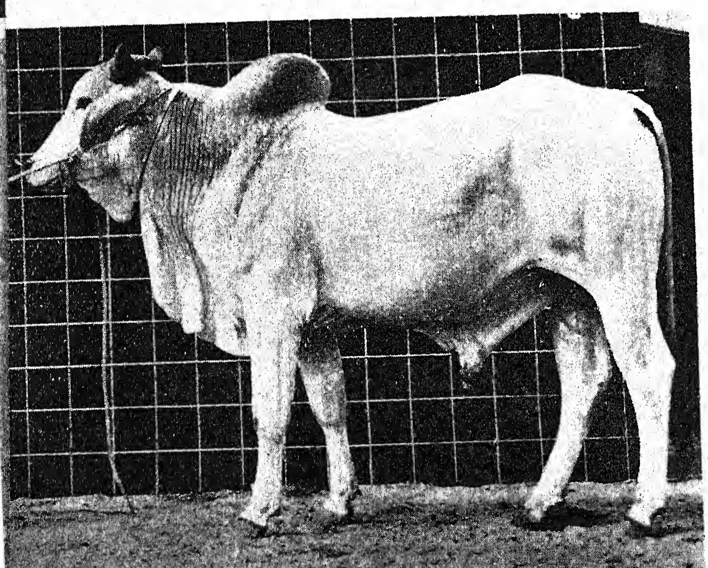


Fig. 11. Bull : Government Cattle Farm, Sind.

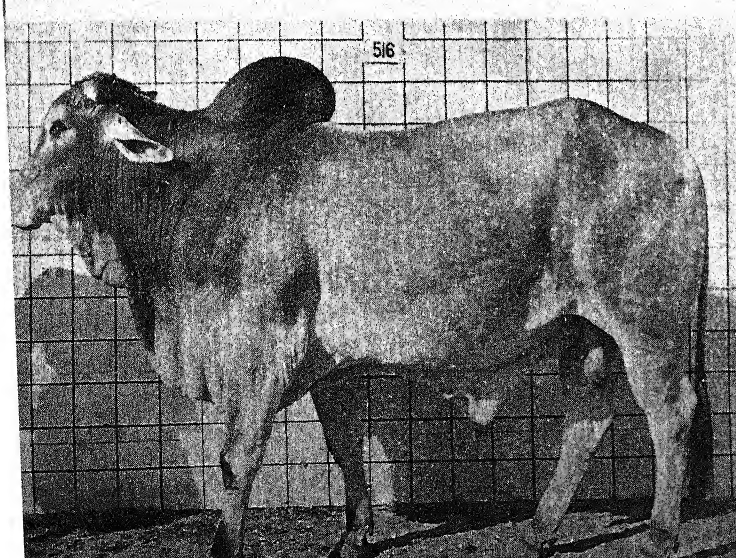


Fig. 12. Bull : Karnal herd of Imperial Agricultural Research Institute.

from that area to collect a herd of one type or another according to which is desired. The foundation stock of the Karnal Farm was selected for milk production and it is probable that, that being the first consideration, there would be no great insistence upon uniformity of bodily type; the herd has been constantly bred ever since its foundation through certain families and again always with higher milk production in view; accordingly the members of the herd now bear a stamp which is typical of the farm-bred stock. On the other hand, the breeders who have established herds under farm conditions in Sind require good bullocks just as much as good milking cows; the type they, therefore, selected and bred, not through family or line breeding but very largely by periodic recruitment from the original source, have differed somewhat from the Karnal herd (Plates 14 and 15). Neither in the farm herds, nor in the desert herds, can breeding even now be done with the certainty of obtaining the consistent results, as far as visual characteristics are concerned, which can be had from breeds such as the Kangayam, Kankrej, Sindhi, and others, but, on the other hand, none appears to have the breeding adaptability which the Tharparkar possesses. A study of Plates 16, 17 and Plate 12, fig. 1 will show that the variations found in the desert herds are still cropping up in the Karnal herd and illustrates the fundamental heterozygous character of the breed.

For a number of years a herd of Hissar cattle was maintained at the Imperial Agricultural Research Institute Farm at Karnal as well as the herd of Tharparkars and the criticism is often made that a certain amount of cross-breeding took place either intentionally or by accident in spite of assurance to the contrary by the farm authorities. It appeared to the author, however, after his visit to the Thar country, that many of the individuals he had seen in the herds there resembled so closely those in herds of other grey breeds of cattle that it would be difficult to assert that they did not carry blood of one or other of these breeds, and it was on that account that the purity of the Karnal herd was questioned. To test the point, the three photos in Plate 18 (figs. 18-20) were submitted to six authorities with the request that they would indicate if in their opinion any of the cows illustrated could be accepted as Tharparkars, not in the show ring, but as ordinary commercial animals. The first authority accepted fig. 20 as an illustration of typical Tharparkar and made no further comments. The second considered that fig. 20 might be accepted as Tharparkar, but that figs. 18 and 19 quite definitely were not. The third thought that fig. 19 might pass as a Tharparkar, but not the others. In the fourth's opinion, fig. 20 was a typical Thari or Tharparkar, fig. 19 was a good type of that breed, and fig. 18 was somewhat atypical but passable. The decision of the fifth authority was that fig. 20 is passable, fig. 19 is nondescript and fig. 18 is positively not a Tharparkar. The sixth's opinion was that while there were many cows in the Karnal herd which resembled those illustrated, they are towards the Hariana type rather than the Tharparkar.

In fact, figs. 18 and 20 are illustrations of Hissar cows in the milking herd of the Punjab Government Cattle Farm at Hissar; they were born and bred on the farm and are registered in the herd books. Fig. 19, on the other hand, is an illustration of a typical individual of a small herd of *gowala's* cows which was the first the author met on going out of his quarters in Delhi to photograph a type of animal which is seen in considerable numbers in Delhi and which are doubtless Hissar grade cows. This test further confirms the heterogeneous nature of the Tharparkar, and it also demonstrates that there is probably no foundation for the criticism that cross-breeding with Hissar cattle has occurred at the Karnal Farm.

APPENDIX

Description and characteristics of the Tharparkar breed

The home of the Tharparkar breed is the arid semi-desert tracts of south-east Sind. It is found in greatest purity in the vicinity of Amarkot, Naukot, Dhoro Naro and Chor. This tract covers an area of about 8,000 square miles and consists largely of sand dunes running parallel from south-west to north-east and is bounded on the south by the Rann or treeless desert of Cutch, on the east by the Marwar State, on the south-east by Palanpur Agency and on the west by the alluvial plain of Sind. The height of the dunes or *bhits* ranges from 50 ft. to 300 ft. The villages, consisting of a few huts, are far apart and are built round a *tarr* or well.

The rainfall is limited to about 10 in. a year and is very irregular and the depressions

between the *bhits* act as catchment areas and are cultivated with quick-growing millets like *bajra*, pulses like *guara*, etc.

The sand dunes are covered with brushwood and types of mimosa and also permanent bushes and during a season of good rain grasses spring up profusely. The limiting factor for cattle-breeding is the number of wells which are far apart as well as deep. The depth is 100 to 200 ft. and water is lifted by leather buckets drawn by a pair of camels, cattle or four to six donkeys.

The cattle remain loose in the jungle throughout the 24 hours, coming back only once a day in the morning to the well for watering purposes and for milking.

Stall-feeding is not the practice, but in big villages and towns during dry weather milch cows are helped with a little *guara*, *bajra* and a small ration of steeped or boiled *guara* seeds. It will be seen, therefore, that for animals to thrive under such conditions they must have: (1) great power of endurance and resistance to famine and drought, and (2) ability to cover long distances under desert conditions, hence balance and ease of carriage.

The cows are good milkers and the bullocks are good workers of medium weight and useful for both plough and carting. Owing to these qualities as well as to their hardy constitution and ability to thrive on scanty fodder, Tharparkar cattle are now being bred at several government farms away from their natural home, and they are proving very popular for the improvement of small local breeds in other parts of the country. Although even under desert conditions the average lactation of the milking cow is estimated to be 2,500 lb., much higher yields are obtained under farm conditions, the average being 4,349 in 286 days, but yields as high as 9,655 lb. in 305 days have been recorded.

General characteristics

The typical Tharparkar is a deep, stockily built animal of medium size and good quality with straight limbs and good feet. It has a strong well-proportioned frame with good bones and joints of fine quality. The males give a general impression of virility.

Head: Medium in size.

Forehead: Broad and flat or slightly convex above the eyes. The front of the horns and face are practically in one plane; in bulls the convexity may be slightly more pronounced. A boldly convex forehead is not acceptable.

Face and muzzle: Lean and fine, slightly dished to the muzzle, which with the nostrils are broad and black; lips are muscular and jaws strong.

Eyes: Full and placid.

Ears: Somewhat long, broad and slightly pendulous. A rich yellow colour of the skin inside the ear is preferred.

Horns: Set well apart curving gradually upwards and outwards in the same line as that of the pole, with blunt points inclined inwards; moderately thick at the base, that is, from 5 in. to 7 in. in circumference just above the skin in cows, and tapering gradually, being about 7 in. to 9 in. long as measured in the inner curve. In the male, the horns are thicker, shorter and straighter than in the female. Horns much thicker at the base or much longer are not acceptable.

Neck: Of medium length, clean cut and neatly joined to head and shoulders.

Dewlap: Loose and flexible but not voluminous, the skin is fine and mellow.

Chest: Deep and full between and just behind the forelegs. Breast is broad but not coarse or heavy in the brisket.

Legs and shoulders: Shoulders are light, with a good distance through from point to point but thin at the withers. The hump is moderately well-developed in the male, but firm and placed in front of the withers. The legs are comparatively short but proportionate to size with strong knees and hocks and fine quality bone, the ankles are straight and strong, the feet well-rounded and of medium size, pasterns are short, the legs are carried straight so as not to weave in walking.

Back: Strong, straight and moderately long.

Ribs: Well-sprung from the back and curving evenly with a large abdomen firmly held up.

Navel: There is a well-defined flap of skin at the navel corresponding to the sheath in the male, but it is not coarse or long. The sheath is of moderate length and not markedly pendulous.

Loins and hips: Loins are broad and strong, flat from side to side and as nearly level with the hip bones as possible. Hips are broad and quarters long and drooping slightly to the root of the tail.

Rump and pin-bones: Level and in line with back. Pin-bones well apart with good length

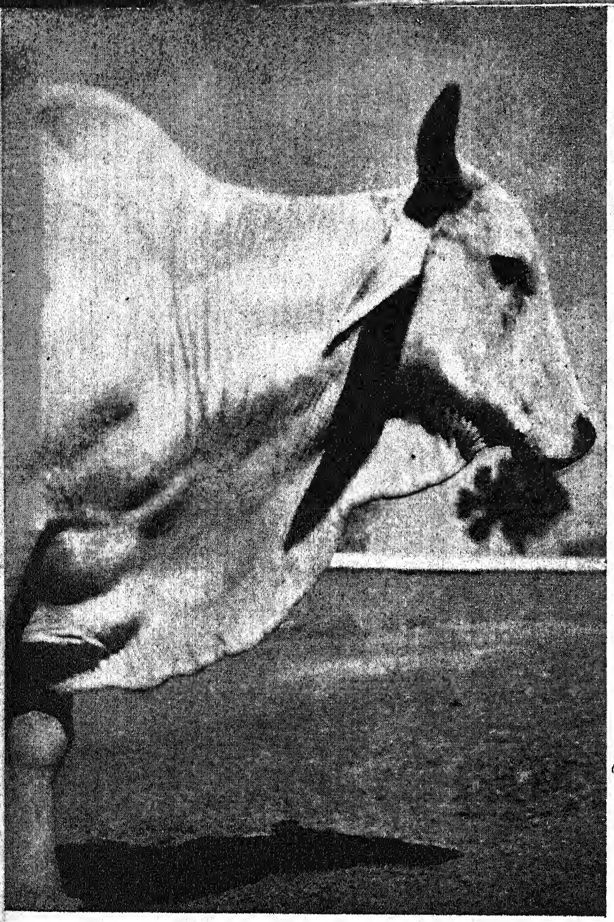


FIG. 13. Head of bullock bred near Mithi, and now in the possession of Sind Agricultural Department.

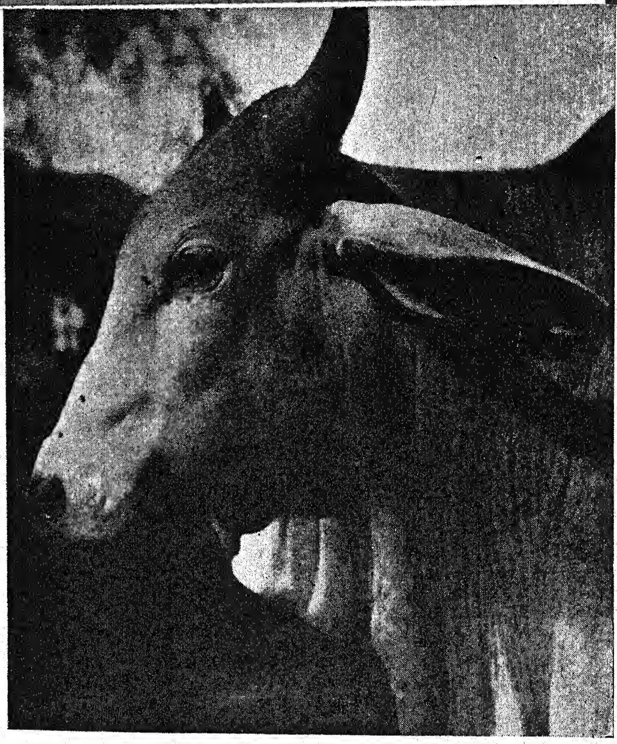


FIG. 14. Young bull in I.A.R.I. herd, Karnal. Compare with Fig. 13.

FIG. 15. Young bull at Islamkote with Kankrej type of poll.

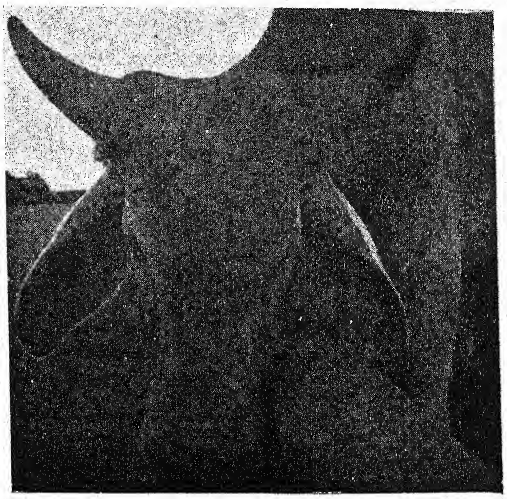


FIG. 16. Young bull in I. A. R. I. herd, Karnal, with Kankrej type of poll. Compare with Fig. 15.

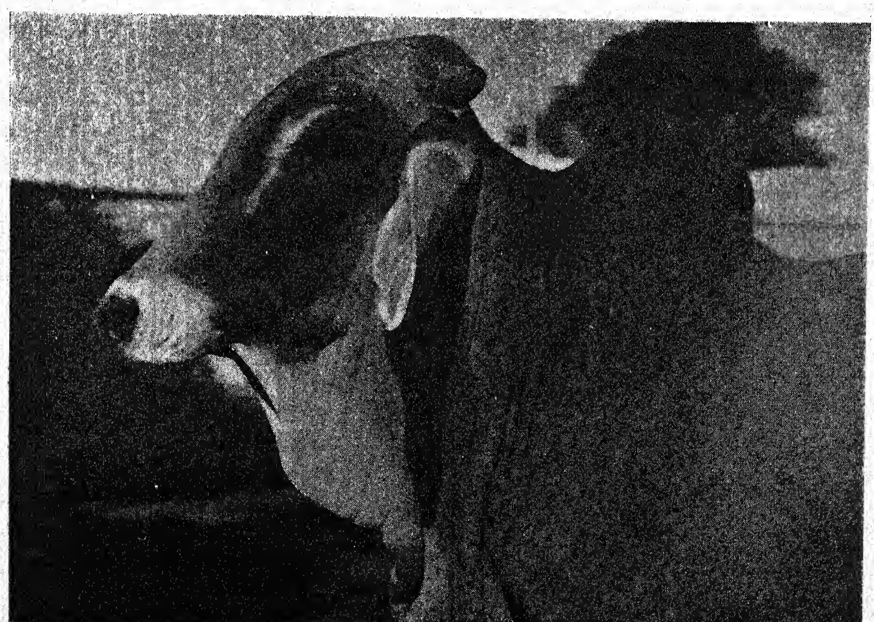


FIG. 17. Young bull in I. A. R. I. herd, Karnal, with Gir type of head. Compare with Plate 12, fig. 1.

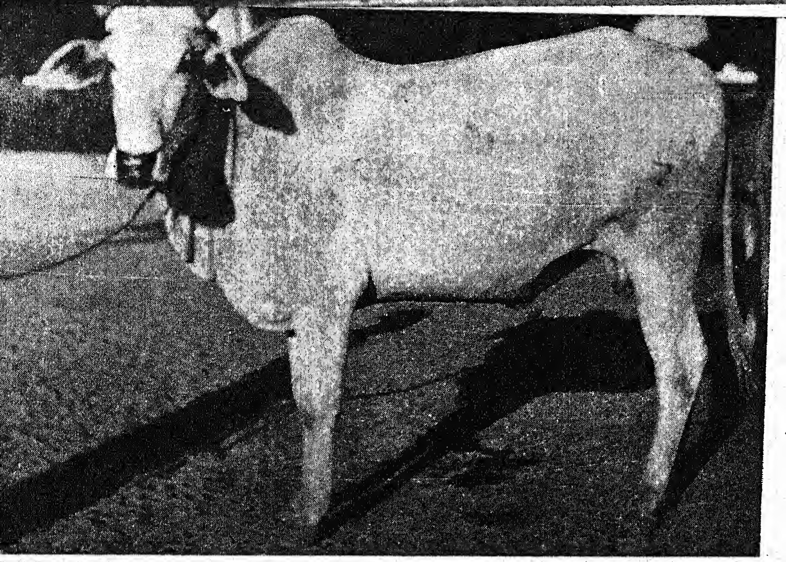


FIG. 18. Hissar cow in the milking herd of the Government Livestock Farm, Hissar.

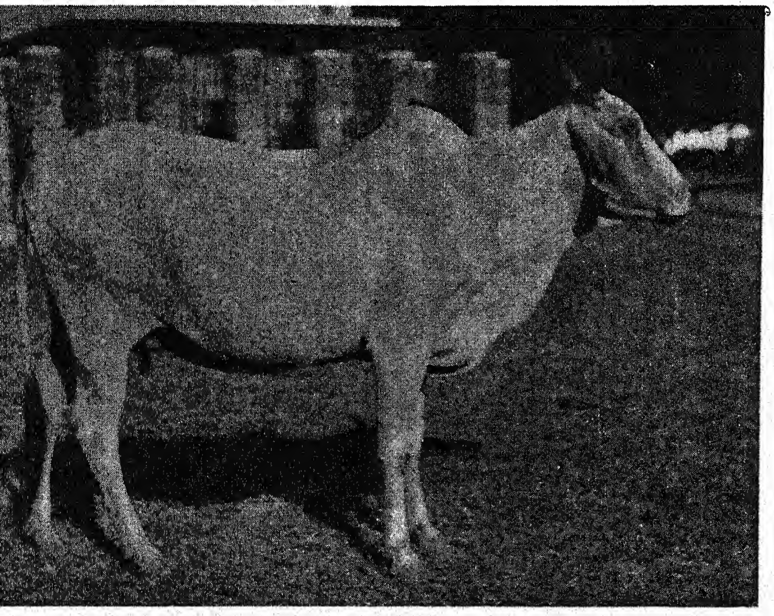


FIG. 19. A typical individual of a small herd of *gowala's* cows.

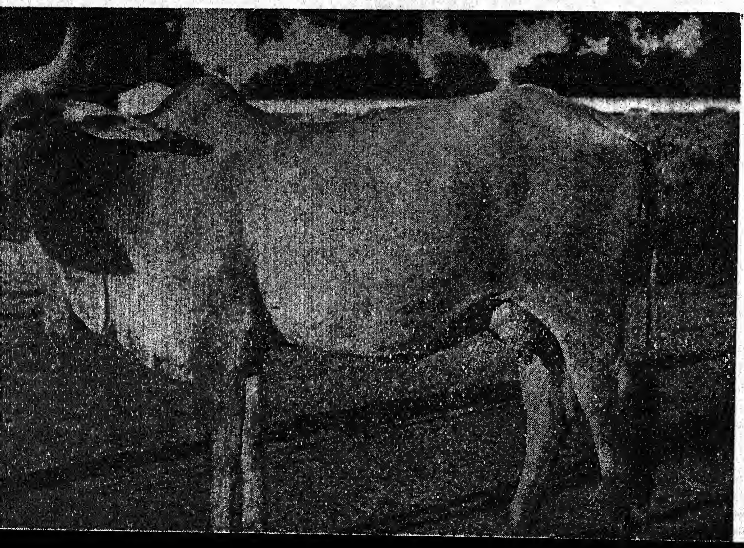
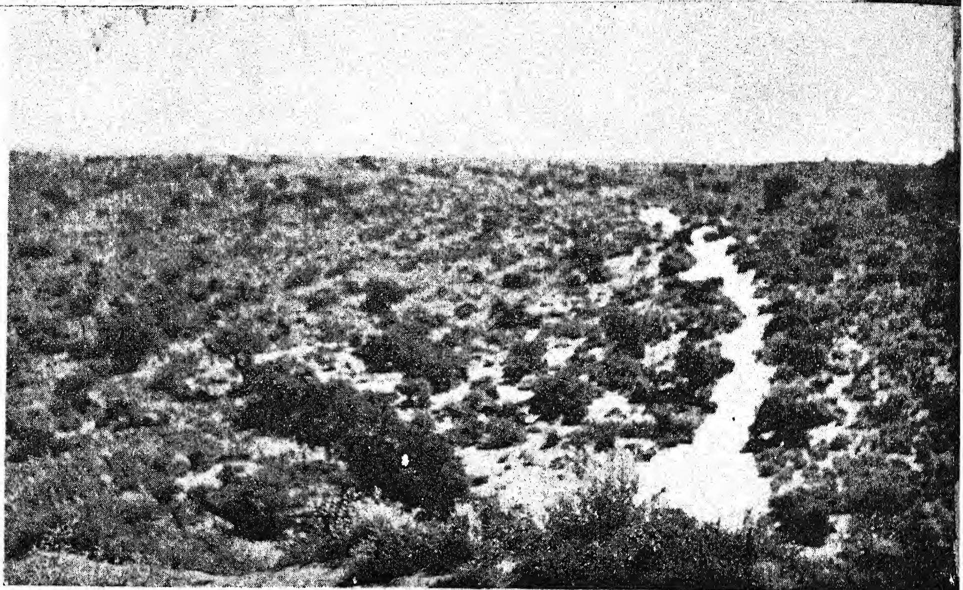
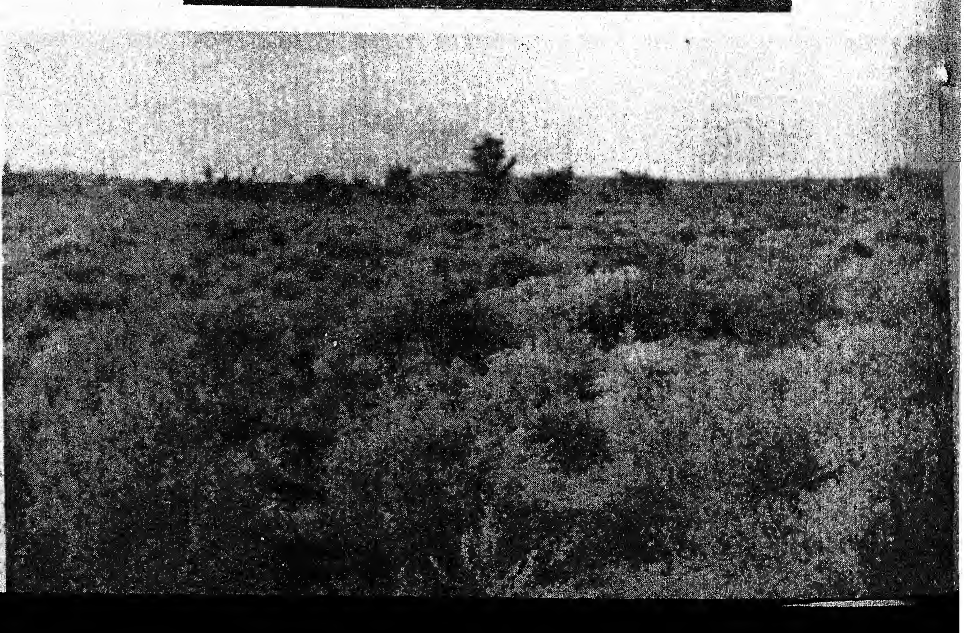


FIG. 20. Hissar cow in the milking herd of the Government Livestock Farm, Hissar.



G. 21. The Islamkot-Diplo road.

. 22. Grazing land near Khari Ghulam Shah.



23. Herbage east of Islamkot.

PLATE 19

from hook to pin-bones.

Flanks: Well let down and hollow in cows, not pendulous.

Thighs, buttocks and twist: Thighs are wide and fairly muscular but giving ample room for the udder and dropping straight from the pin-bones.

Tail: Thin and supple; hanging loosely so that the end of the switch is 2 to 6 in. off ground. Switch is black.

Hocks, legs and hoofs: Hocks well under body and set apart, legs with good bone, hoofs hard and black, moderate size, no tendency to turn out.

Udder, teats and milk veins: Udder is large and well-developed in front and rear and is carried well up at the back. Floor of the udder is nearly level and not deeply cut up between quarters. The skin of the udder is fine and mellow with a yellow tinge and prominent veins. Teats are three to four inches long, uniform in thickness and set at even distances.

Skin and hair: The skin is of fine quality, loose and mellow to touch. The colour of the skin is black, except on the udder, under the belly, on the lower part of the dewlap and inside the ears where it is rich yellow. The hair is fine, short and straight, but in the male it is slightly curly on the forehead. The colour is white or grey, in some animals dark grey, with a light-grey stripe along the backbone. The face and extremities are of a darker shade than that of the body, and in the bull, the neck, hump, and the fore-and-hind quarters are also darker.

Measurements of typical Tharparkar animal
(In inches)

	Male		Female	
	Max.	Min.	Max.	Min.
Height, behind hump ..	53	48	51	45
Length from point of shoulder to pin-bone	64	57	60	54
Length of quarter from angles of hip to pin-bone ..	20	17	18	16
Height at angles of hip	53	48	50	45
Width between angles of hip ..	20	16	19	15
Height at pin-bone ..	49	44	46·5	41
Girth ..	75	64	71	62
Height at point of elbow	31	26	29	24
Measurement of bone below knee ..	9	7	7·5	6
Length of face immediately above eyes ..	10·5	9·5	9	7·5
Length of lower surface of ear measured from tip to junction of ear to face ..	14	11	14	11

THE DANGER OF VITAMIN DEFICIENCY IN POULTRY

By S. G. IYER and R. MUKHERJEE

THE vitamin-A deficiency in Indian poultry occurs to a greater extent than what has hitherto been supposed. The scarcity of green fodder is most acute in this country during the couple of months in summer preceding the monsoon. The greatest incidence of avitaminosis-A is, therefore, usually observed in May and June.

Necessity for constant supply of vitamin-A rich feeds

Poultry, like other farm-stock, require vitamin A in their food at all stages of life. They have to depend almost entirely on the vegetable products for its supply, unless some fish liver oil is included in their ration. The vitamin-A activity of plant materials is due to certain pigments, such as carotene and cryptoxanthin, and not to vitamin A itself. These pigments are called pro-vitamin A, since they are converted into vitamin A in the liver.

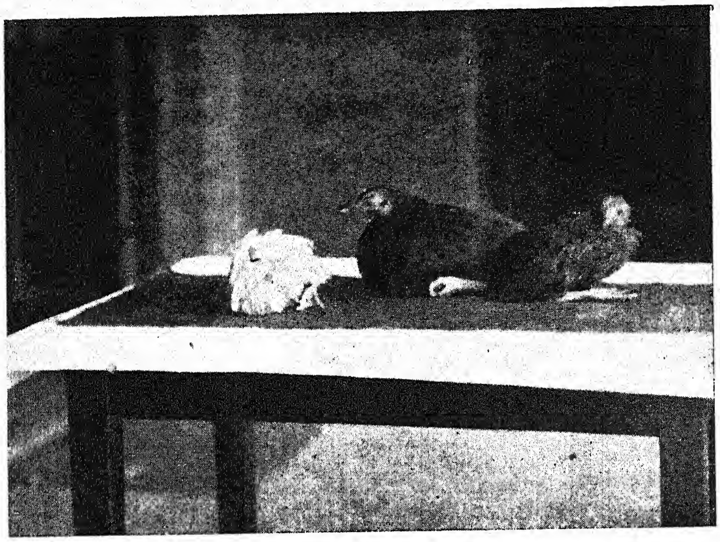
Yellow-maize is universally recommended as a component of poultry rations, because it is fairly rich in cryptoxanthin. The vitamin-A activity of grains, vegetables (both fresh and dried) and fish liver oils slowly deteriorates on keeping. After several months' storage under Indian conditions, such products may retain only a fraction of their original potency. This being the case, it is always safe (1) to prepare the mash for only one or two weeks at a time, (2) to exclude very old and rancid ingredients, and (3) to supply adequate amounts of fresh green vegetables to the birds throughout the year. In rations containing but small amounts of meat or milk products, the inclusion of liberal quantities of greens not only supplies sufficient quantity of pro-vitamin A but also of other vitamins, such as those of the B-complex. For birds kept indoors, it is of course advisable to include 1 per cent cod-liver oil (veterinary) in the ration to prevent rickets arising from avitaminosis-D.

S. G. IYER and R. MUKHERJEE are on the staff of Poultry Research Section, Indian Veterinary Research Institute, Izatnagar.

The necessity of constantly providing vitamin-A rich feeds arises from the fact that even in fowls fed on adequate diet the capacity to build a reserve of this vitamin in their livers is limited. In view of this, whatever reserve is present is soon exhausted if the birds are switched on to a ration poor in vitamin A. The vitamin requirement of young chicks is greater than that of older birds, but the liver reserve of the former is relatively low. Consequently, if the rearing ration is deficient in vitamin A the liver may be depleted of this vitamin by the end of 7 to 14 days, even though the vitamin-A content of the egg from which the chicken is hatched has been high. The first five weeks of the chick's life is considered to be critical from the standpoint of vitamin-A metabolism. As the demand for the vitamin is there from the earliest stage of the bird's development, it is clear that its adequate supply in the diet is a prerequisite to minimize mortality losses and improve the general health and production. In order to impress the importance of the problem in poultry-farming an account is given below of serious losses in birds attributable to a deficiency of vitamin A in the ration.

Incidence of avitaminosis-A in poultry

During the summer months (May and June) of 1945 and 1946, large numbers of 8 to 14 weeks old chickens belonging to Military Poultry Farm at Izatnagar were lost owing to a disease of one or both eyes. The same condition was diagnosed in a small number of cases among the rearing stock on the Institute Farms in 1945. In 1946, in two other military poultry farms each having 4,000 to 6,000 stock, this condition was found responsible for the loss of over 10 per cent of the rearing stock. Owing to the seriousness of the eye trouble, affected birds had to be destroyed. From the date changes in the eye were noticed to within a fortnight clinical evidence of the vitamin-A deficiency was recognized in almost all the pens of the farms. A consignment of



Swelling of the eyes with cheesy deposit due to vitamin A deficiency.

PLATE 20

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nine chickens affected with varying stages of inflammation of the eye was received for autopsy from one of the farms. Laboratory examination indicated each one of these cases to be due to avitaminosis-A which was confirmed by vitamin-A assay of the livers of the affected birds.

The seriousness of this condition of growing chickens which are mostly reared for replacing the old stocks will serve to draw the attention of poultry-keepers in the country to the necessity of adequate rations well balanced with essential food factors for all classes of fowls.

Clinical symptoms

In the cases examined, usually only one of the eyes was affected. The first symptom was a serous discharge from the eye and redness of the conjunctiva. This was followed by a swelling of the eye, the serous discharge becoming thick and gradually transformed into a thick whitish cheesy deposit inside the eyelids and outside the eyeball. This cheesy material was found to increase daily in quantity until it gave rise to a puffed-up condition of the eye. In a small number of cases there was serous or mucous discharge from one or both the nostrils. Before death or before the birds were killed, there was a general droopiness in the affected birds. They were feeding indifferently, not keen to drink water and were mostly seen inside the house. Over 50 chickens affected with the condition were autopsied. The changes were confined only to the eye, the cornea being opaque leading to a partial or total blindness. No lesions suggestive of fowlpox could be seen in the mouth or unfeathered portions of the body. In some of these cases, pustular lesions, indistinguishable from those caused by vitamin-A deficiency, were found on the mucous membrane of the oesophagus. Internal organs, including the liver, appeared pale. Examinations were negative for any specific bacterial infection. The condition could not be transmitted experimentally into the healthy chicks by inoculating them with the discharge and cheesy materials from the affected eyes. Inoculation of a saline suspension of the cheesy material produced no evidence of fowlpox infection although inoculated birds were subsequently found to be susceptible to fowlpox virus.

By suitable laboratory methods the pathological condition of the eyes in the chickens was shown to be not due to any bacterial or virus infection. The symptoms were observed only during that portion of the year when sufficient green feeds were not available for the birds. Yellow maize, a rich source of provitamin A was not also available. These essential dietetic lapses were probably responsible for the affection in the birds of avitaminosis-A.

Control and prevention

Owing to the more or less permanent nature of the damage to the eyes, individual treatment was considered uneconomic. The following measures were carried out with satisfactory results:

(1) All affected and droopy chickens were culled twice daily and destroyed, in order to prevent any secondary infections.

(2) The house together with the equipments was cleaned and disinfected daily.

(3) Plenty of greens and one per cent veterinary cod-liver oil in the mash were recommended as yellow maize could not be obtained.

(4) One grain potassium iodide per bird for seven days was added to the drinking water of the birds, for the presence of iodine in the system is inimical to the propagation of coryza infection.

(5) All the healthy chickens which were not vaccinated against fowlpox were immediately inoculated with fresh fowlpox vaccine.

The entire trouble subsided within a week after the commencement of these operations.

HOW DROUGHT AFFECTS INDIAN WHEATS

By J. J. CHINOY

THE commonest calamity of the Indian cultivator is the failure of the monsoon which in its extreme manifestation is called drought. Water balance of a plant is upset by drought and as a consequence of this the physiological functions affecting growth and yield are disarranged.

There are two kinds of drought, (1) atmospheric drought, and (2) soil drought. In the former case high temperature and low humidity during certain critical phases of the plant life adversely affect its metabolism; while in the latter case the moisture in the soil falls to such a low level that the plant is unable to replenish its water loss (caused by transpiration) from the soil and enters into a state of permanent wilting from which it cannot recover its turgor even during the cool hours of the night. Drought-resistance of a plant is a very complex phenomenon conditioned by many internal (physiological and genetical) and external (environmental) factors among which its capacity of enduring long spells of wilting with little or no dislocation of the vital functions is one of the most important. The complexity of the problem is revealed by the fact that no method so far tried has given reliable results. This lack of success may be attributed in a large measure to the absence of fundamental knowledge of the physiology of drought-resistance.

The urgent need for securing varieties of food plants capable of escaping the injurious effects of drought becomes apparent when it is considered that nearly 80 per cent of the cultivated land in this sub-continent of ours has to endure seasonal and soil droughts. Even the irrigated and the most productive regions are not entirely free from drought.

During the last five years attempts have been made at this Institute to study the problem of drought-resistance in wheat from the fundamental as well as the practical standpoints.

Study of plant collection

A comparative study has been made of about 260 selected varieties of exotic and Indian wheats grown under 'dry' and irrigated conditions. Growth measurements and yield data have revealed highly significant correlations between the time of flowering, grain yield, 1,000-corn weight, ripening period, ear tiller ratio and temperature during the ripening period. The ripening period in early varieties is long because the temperature is low and humidity is high. As the temperature rises and humidity falls considerably during the months of March and April in Delhi, a condition of atmospheric drought prevails, and therefore, late-flowering varieties are compelled to ripen their grain in a much shorter time. This is further aggravated by the low moisture level in the soil during this period. Consequently grain-filling is adversely affected and yield is reduced.

J. J. CHINOY is a plant physiologist on the staff of the Indian Agricultural Research Institute.

Selection of varieties for different localities

On the basis of the correlation between yield and temperature during the ripening period, selection of wheat varieties for different localities can be made by taking into account the temperature and humidity during the ripening period of a variety. In order to obtain high yields, varieties which escape atmospheric drought during their ripening period must be selected. Thus for instance, varieties with short vegetative periods will have to be selected for localities having a short growing period (November to February), like the Central Provinces. For Delhi conditions wheat varieties with slightly longer vegetative periods give good yields because the growing season is longer. As we proceed from Delhi to further north, say to Lyallpur, later varieties give good yields because the temperature even during March is very conducive for grain-filling. Even very late varieties including winter wheats of England and the U.S.S.R., which set very shrivelled grains at Delhi, form fairly well-filled grains in Baluchistan and hill stations like Simla where the maximum temperature is generally below 80°F. during the ripening period of wheat.

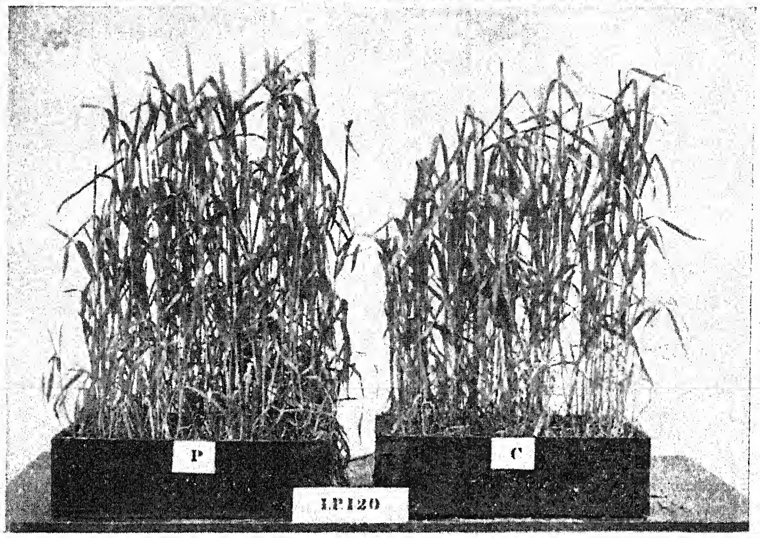

FIG. 1. Plants from 'hardened' (p) and untreated (c) seed of I P 120 wheat

PLATE 21

FIG. 2. Healthy plants from desiccated seedlings I P 165 (V_I) and P 8-A (V_{II})

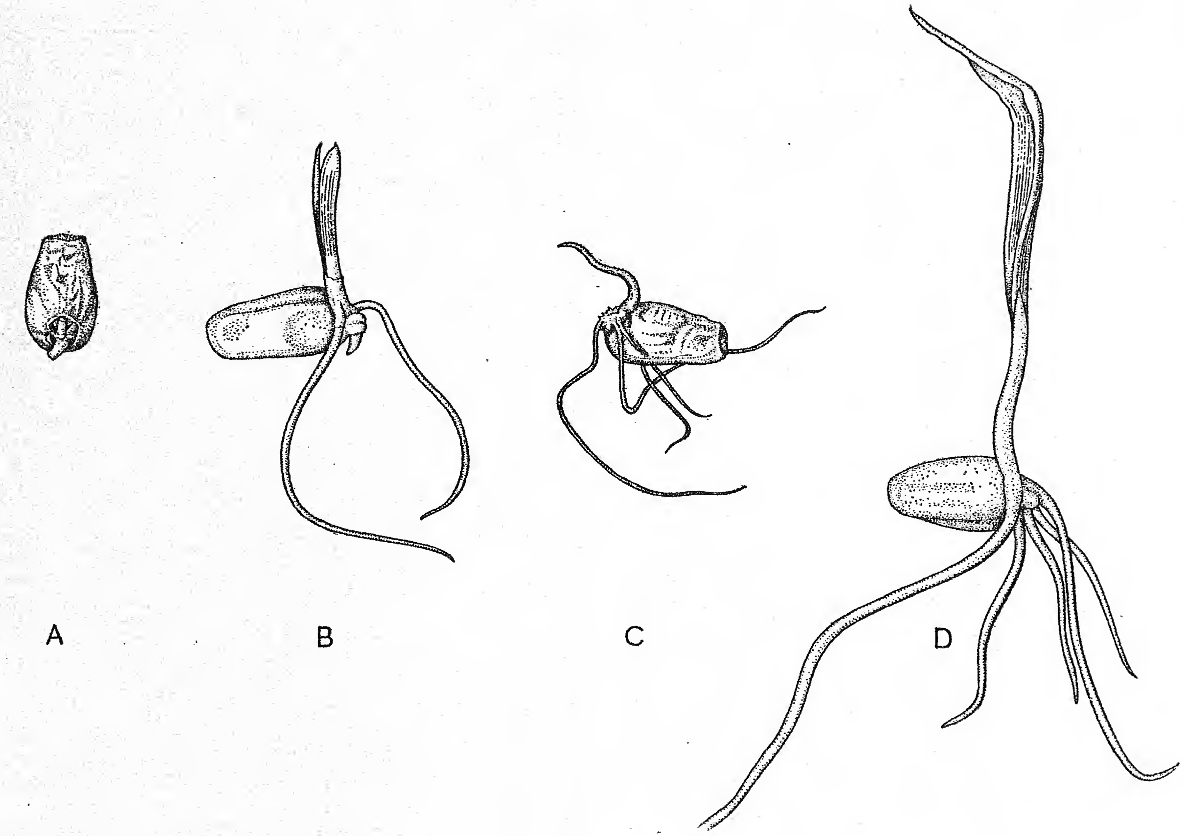

FIG. 3. Revival (Band D) of decapitated (A) and whole (C) desiccated seedlings of IP 165 wheat after eight months' storage (×4)

Resistance to wilting

A number of commercially important varieties have been selected from the above collection and their drought-resistance has been determined by so controlling the water supply of the plants at different stages of growth that they are in a state of permanent wilting for a number of days and then noting their recovery after rewatering them. On the basis of these studies varieties have been classified as resistant, susceptible and very susceptible to drought. A very interesting feature of this work is that, during the early stages of growth (initiation of tillering), all the wheat varieties which have been tried so far show considerable resistance to drought. In fact even after a desiccation period of 15 days (including a seven-day period of permanent wilting) wheat not only recovers from the injurious effect of drought but also gives a slightly higher yield of grain than the control (normal watering).

The practical utility of this result is that, in those regions where irrigation facilities are available in our country, irrigation of a wheat crop can profitably be delayed for about 45 days after sowing even if plants show symptoms of wilting during the day, thus affecting a saving in water. It is needless to say that sufficient moisture should be made available at the time of sowing to ensure good germination.

If, on the other hand, plants are wilted during the 'shooting' and the flowering stages they suffer considerably in growth and yield. Both these phases are very critical in the life of a wheat plant and deficiency of water or prevalence of high temperature during these phases are very detrimental to yield.

Methods of hardening plants to drought

(1) A simple seed treatment has been developed which induces resistance to drought in plants. Seeds are soaked in water and allowed to absorb moisture up to 35 per cent of their weight and kept in a swollen condition for about six hours at about 25°C. (lower temperature 15°C. has been found to be more beneficial). These are then spread out in a thin layer for drying in the shade for two to three days. During this period the seed gets dried almost to the original weight. This treatment is repeated three or four times.

(2) The above method of alternate soaking and drying has also been tried using solutions of varying concentrations of a number of chemicals such as, sodium choloride[1], sodium sulphate, potassium nitrate, calcium chloride, ammonium sulphate, potassium chloride and others instead of water.

(3) High-temperature treatment of seed has also been attempted for inducing resistance to drought.

The results obtained so far have been very encouraging: (a) These treatments accelerate germination and the growth rates of seedlings. (b) Treated plants recover much more quickly from wilting than those from untreated seed. (c) Flowering is slightly accelerated in treated plants. (d) Treatment with various chemicals induces resistance to salinity as well as to drought. (e) Seeds of a number of varieties are able to withstand high temperatures (80° to 105 C.) for prolonged periods (24 to 46 hrs.) without any loss of viability. (f) Treated plants are generally better in yield and growth. (g) All these treatments have been tried on a field scale. (h) Large-scale experiments with seed hardened according to No. 1 treatment have given a yield of 948 lb. per acre compared to 866 lb. per acre given by untreated seed (average of three years' trials) on dry land.

Limit of desiccation

Experiments were also made to see how far wheat seedlings can be desiccated without loss of vitality. They were germinated under restricted supply of water and then gradually desiccated at a certain growth stage. The most interesting observation from this experiment was the complete recovery and revival of completely desiccated seedlings in which the coleoptile had reached a length of 1 to 2 cm. and rootlets 3 to 4 cm. Even after a storage of about eight months such desiccated seedlings revived and grew to normal healthy plants.

Much remains to be done by way of understanding the physiological mechanism which imparts to the living matter at certain stages of its life such extraordinary resistance to desiccation. A dormant embryo of wheat, for example, can withstand 100° C. for 24 hours and can even defy the temperature of the liquid air without injury. Further progress is, however,

[1] Originally reported by Henckel and Kolotova (1935). *Imp. Bur. Pl. Genet. Bull.* 17, pp. 105. In India Dr P. Parija (*Curr. Sci.* 12: 88-9, 1943 : & *Proc. Natnl. Acad. Sci. India,* 15: 6-14, 1945) has tried these treatments on rice for inducing drought and salt resistance.

dependent upon the provision of glass houses with rigidly controlled conditions of temperature, humidity and illumination and also other facilities for disentangling the influence of the environment from that of the genetic factor for drought-resistance.

PURITY OF FARMER'S SEED WHEAT

During the last two years, the cerealist at the Dominion Experimental Station, Scott, Sask., has noted a decided improvement in the purity of seed wheat being used in west central and north-western Saskatchewan. This is believed to be due in part to the fact that farmers are becoming more conscious of the advantages of using seed of good purity and to the improved financial conditions of farmers which have enabled them to purchase registered seed.

In a project designed to determine the varietal purity of farmer's seed wheat, where samples are classified as 'A', 'B' and 'C' according to the varietal purity, the percentage of A samples during the last two years has increased from 28 per cent to 54 per cent, while the percentage of B and C samples has decreased from 72 per cent to 46 per cent. A sample is classified as 'A' if it contains no more than 0·2 per cent of a major off-type or other variety. A 'B' sample is allowed one per cent impurities and a 'C' sample is one containing over one per cent impurities. A sample is classified as a mixture if it contains over 10 per cent of other varieties.

An interesting feature of the study is the fact that, in areas where Thatcher, a more or less new variety, is being grown extensively, the varietal purity of the seed wheat is high, while in areas where Marquis and Red Bobs are still being grown, the varietal purity of the seed is distinctly low, with a large percentage of mixtures and C samples.

In these latter areas, during the last couple of years, a redeeming feature is that quantities of registered seed of recommended varieties are being obtained and this is gradually remedying the situation. It is in these areas where farmers are still growing varieties which are not recommended that the largest percentage of poor seed is to be found.

In areas where this condition prevails, farmers may incur serious financial losses from lower grades, from shattering and from delays and difficulties in harvesting. A crop which has a mixture of varieties may contain plants some of which will mature early and some late. Such a condition will result at harvest time in immature kernels, over-ripe kernels and shrunken kernels, all of which will lower grades. Today, when combines are being used so much for harvesting, uneven ripening will not only cause serious losses from shattering but may cause losses from heating in stored grain because of the presence of green kernels.

The encouraging feature of the study is that, in areas where most farmers are growing recommended varieties, the varietal purity of the seed wheat being used is good. This is very noticeable in areas where Thatcher is the only recommended variety. Being the only variety grown precludes the possibility of mixtures creeping in.—*Experimental Farm News*, May 20, 1946: Issued by Department of Agriculture, Ottawa, Canada.

APPLICATION OF SCIENTIFIC PROCESSING TO INCREASE THE NUTRITIVE VALUE OF COARSE FOOD MATERIALS

By V. SUBRAHMANYAN

SCIENTIFIC methods can be applied for the processing of food materials for different purposes, e.g. (1) improved storage by removal of excessive moisture, elimination of pests of different kinds and dehydration by various methods, (2) minimizing cooking and other routine operations connected with the preparation of food, (3) concentration and preservation of different forms of perishable foods such as fruits, vegetables, meat, fish, etc. and products prepared out of them, (4) treatment of low grade and coarse food materials to improve their taste, flavour and nutritive value, (5) fortification of food materials with the necessary vitamins, minerals and other food essentials, and (6) preparation of food materials from hitherto undeveloped sources. All these are important and must be developed on a greatly increased scale. The most important of these, not only for India but also for most other parts of the world, is the processing of coarse food materials to improve their nutritive value. In course of time, the exploitation of hitherto undeveloped sources for the preparation of human food will also become very important.

Evaluation of food material

The normal nutritional requirements of a person would depend on age, profession and other related conditions. To take an instance, an adult with a moderately active occupation would require food with a calorific value of 2,500 and containing about 70 gm. of protein, 1 gm. of calcium, 12 mg. of iron, 5,000 International Units[1] of vitamin A, 2 mg. of vitamin B_1, 15 to 20 mg. of nicotinic acid, 75 mg. of ascorbic acid and 400 units of vitamin D per day. To secure this gross requirement, various types of diet recipes, suiting different levels of income can be prepared. At one time, these recipes were considered to be satisfactory but now with increasing knowledge, we have to recognize that they do not take us very far. A food has to be evaluated, not by what it contains, but by what it yields by digestion in the body, by the digested material that is actually utilized. Thus, it is possible for one to eat a lot of protein-rich material and still suffer from protein deficiency, to eat millets and vegetables rich in certain minerals and vitamins and still show acute deficiency of the same food constituents.

Two categories of food products

From quite early times, people have learnt empirically to assess the quality of food products. Quality is not easily definable in terms of well-known chemical and other entities, but the general evaluation is something definite and reproducible by a representative panel of consumers. Apart from well-known properties like appearance, taste, flavour, etc. there are also specific attributes like ease of cooking, digestibility, general well-being, protection against commoner ailments and so forth. Based on this, foods have been placed in two main categories—high class diets such as meat, eggs, fish and milk and low class diets like millets, pulses, most of the cereals and coarse vegetables. Even when taken at the same proximate levels, the high class food leads to better growth, better health and more resistance to disease than the low class ones. The reason for this big difference lies in the fact that, in the human body, the former is better utilized than the latter. It follows, therefore, that if we are to get the best value out of our foods, we either have to take high class foods or convert low class foods into high class ones.

[1] International standard accepted at the Hot Springs Conference of 1943.

Prof. V. SUBRAHMANYAN, D.Sc., F.R.I.C., F.N.I., is a distinguished biochemist and is on the staff of the Indian Institute of Science, Bangalore.

India's alarming food position

If it is feasible, the simplest course would be to produce increasing quantities of the high class foods. This is actually what is being done in countries with large areas and limited populations, e.g. Australia and Canada or those which are so well developed in industries that they can easily buy all their requirements of high class food, e.g. Great Britain. The position is, however, very different when we come to very densely peopled countries like India and China which are also lacking in industrial and other forms of wealth. According to the 1941 census, India's population is about 390 milions. As far as we can make out this census was not quite complete. The actual population might have been even more. Granting that the above is correct and that the population had increased in the normal way, the population in the beginning of 1946 should be near about 420 millions. This was forecast by Hutton, the author of the 1931 Census Report, who also expressed considerable diffidence about the food position, if something was not done to check the alarming increase in population.

In recent years, agricultural production has shown distinct improvement in Sind and to some extent in the Punjab, but over most other parts of the country it has either remained stationary or shown only slight improvement. In some, it has even fallen below the normal level. In any case, the total overall increase in production is nothing like 20 to 25 per cent over the 1931 level which is about the total increase in population. Granting that the population continues to increase at the same rate, we will have to produce at least 50 per cent more food by 1955 than we have done during the past decade.

Increasing production of coarser foods

It is well known that the high class foods like animal products require much more land than the equivalent of grains and pulses. If we are to produce the increasing requirements of the country, we will require as much as four to five times the amount of land that we now possess. As things stand, this would be impossible. The chances are that, instead of raising more fodder and concentrates for animal food, we will have to produce more of the coarser types of food to meet the living requirements of the increasing population. This is what has happened over many parts of China where with the increase in human population, the animal population has considerably diminished. The same thing is expected to happen in India.

Value of processing

It is clear therefore that, if we are to improve the nutrition level of our people, we will have to concentrate on the processing of low grade food materials to enhance their nutritive value. This is definitely possible, provided the food material contains the necessary food constituents. Millets and pulses are well suited for processing, but plain starchy tubers like sweet potato and cassava will not be suitable. The latter are highly deficient in food essentials and no amount of processing will increase their food value.

To cite an instance, the soyabean, which has lately been the subject of considerable controversy, has a very poor food value when used whole as *dhal*. The protein of the same bean becomes nearly four times as valuable if it is steeped, incipiently germinated, mashed and made into a milk. The resulting milk is, nutritively, nearly as good as dairy-fed cow's milk. This shows the value of processing in increasing the nutritive values of the coarser types of food materials.

Methods of processing

Some of the methods of processing are very simple and can be easily introduced even in household operations. Steeping, germination, mashing followed by sieving, cooking to form emulsions and such like can be introduced increasingly in culinary practice. Steaming, roasting and frying can be combined with such treatments. There are, of course, other operations such as high pressure cooking, with or without some pre-treatment, explosion of the cell matter, use of digestive enzymes, roasting and baking under special conditions which can be done only under factory conditions and with proper scientific supervision. These can be standardized and when done on a sufficiently large scale, they should also work out quite cheap. It goes without saying that the products obtained by different methods should be repeatedly checked by systematic analyses, animal experiments and large-scale trials with

sections of populations before they can be pronounced to be distinctly superior to the untreated materials.

Organized research

Developments such as the above will be possible only if scientific and technological researches in these lines are liberally supported. There should be organized approach and a number of research laboratories should join together in the study of this subject of great importance. There is one more important subject which will also require development side by side with the above lines of study. There are several materials, e.g. edible seed-cakes, which are rich in valuable food constituents and which, with some processing, can yield high class human food products. Some developments in this line have already taken place and we are aware that advantageous applications of some of these are already availed of in Europe and America. A useful beginning in this line has already been made under the auspices of the Council of Scientific and Industrial Research. A great deal more of work, preferably on team-work basis, is needed before any substantial progress can be achieved.

HOOVER ON INTERNATIONAL FOOD SITUATION

MAKING a statement over the radio on his recently completed 50,000-mile food mission, ex-President Hoover, Honorary Chairman of President Truman's Famine Emergency Committee, said that on his return from Europe and Asia one month ago his colleagues and he felt assured that as from May 1, the gap in the bare subsistence world supply of cereals had been reduced from 11 million tons to about 3,600,000 tons; and that in the two months since these estimates were made the world had developed even further additions to world supplies, as a result of which it now seemed assured that this gap could be closed. But ultimate victory over mass starvation would depend, emphasized Mr Hoover, upon three assumptions, viz. that the drastic food regimes in food deficit countries would be continued, that people in food surplus countries would continue their sacrifices and that supplies would be shipped overseas in an uninterrupted stream. Mr Hoover did not take the extreme pessimistic view of world supplies after the coming harvest but it must not be thought that all trouble was over. Famine would linger in China and India, said Mr Hoover, until November when the rice crop came. Mr Hoover concluded: 'The food situation of the world next year will not be easy, but in my view, will not be one of such dreadful crisis and drastic regimes as the one which we are now in. —*Press Information Bureau, Food Bulletin*, Vol. 1, No. 7.

PYRETHRUM CULTIVATION IN KASHMIR

By R. N. CHOPRA, L. D. KAPOOR, K. L. HANDA and I. C. CHOPRA

THE systematic cultivation of pyrethrum plant in India, as a source of powerful insecticide, was taken up by the Forest Department of Kashmir State as early as 1931. Many unsuccessful attempts to grow the plant from imported pyrethrum seeds were made and it was not until 1934-35 that few viable seeds were procured from Vilmorin-Paris which successfully germinated in Kashmir. Incidentally Puntambekar[1] outlined the possibilities of pyrethrum cultivation in northern India and predicted that it had a bright future in this country. The Forest Department under the able guidance of Sir P. H. Clutterbuck, then Chief Conservator of Forests, at once decided to put this idea into practice with all the zeal that it deserved[2].

Experimental cultivation

Seeds, which were procured with difficulty from Vilmorin-Paris and which had germinated were transplanted. These plants yielded some flowers and seeds were carefully collected for raising more plants. The germination percentage was much better than the previous year showing that the plant was probably getting adapted to the Kashmir soil. The Forest Department could ultimately collect 6 lb. of seeds in 1938 from 2 oz. seeds obtained originally from Vilmorin-Paris. After ensuring the successful germination of the seeds at Baramulla the experiments were carried to places of higher altitudes such as those ranging from 6,000 to 8,000 ft.

The experimental cultivation continued till 1941 when a scheme of production on commercial scale was examined. The pyrethrum industry was thus put on sound economic footing under the direct control of the Forest Department. The Department then created a pyrethrum division under Forest Industries Circle to expand and protect the cultivation of pyrethrum plant in Kashmir. The forest blanks wherever these were available were converted into pyrethrum fields. The Department had to overcome tremendous difficulties in planting pyrethrum on blanks which were otherwise used as grazing pastures by the migratory graziers who opposed its cultivation tooth and nail.

Very little area of land belonging to private holders was used for pyrethrum cultivation. With constant propaganda however owners of private lands offered third or fourth rate land from point of view of food production for pyrethrum cultivation on rental basis in order to get some returns out of this poor quality land. Such land was fortunately found to be quite suitable for pyrethrum cultivation; in fact, the plants flourished in these areas.

Area under pyrethrum

The figures of acreage under this plant are available from the year when it was put on an industrial basis and the progress appears to be quite satisfactory especially considering that the propaganda of 'grow more food' was being pushed on during these years because of the prevailing war conditions. When the food situation becomes easier and poor quality lands can no longer be economically cultivated, these, it is hoped, will be all brought under pyrethrum to the great advantage of the cultivators. The Forest Department hopes to extend its cultivation on every patch of waste land. Table I shows the progress of area brought under pyrethrum.

TABLE I

Area under pyrethrum plant

Year		Approximate area in acres
1941–42	..	322
1942–43	..	896
1943–44	..	1350
1944–45	..	1600
1945–46	..	2100

[1] Puntambekar, S. V., *Indian Forester*, Vol. 60, p. 275, 1934.

[2] Pathania, Thakur Harnam Singh, *Jammu and Kashmir Information*, Vol. 2, p. 24, 1945.

R. N. CHOPRA, L. D. KAPOOR, K. L. HANDA and I. C. CHOPRA are co-workers in the Drug Research Laboratory, Jammu and Kashmir, Jammu.

FIG. 1. Harvesting of pyrethrum flowers

FIG. 2. Pyrethrum in bloom

Cultural practices

It may be said that the agricultural operations in connection with pyrethrum are similar to any other crop. The plant is perennial and if properly tended gives actual flowers for from five to seven years. In actual practice in Kashmir 6 to 7 seers of seeds per *kanal* ($\frac{1}{8}$ acre) are sown in well-prepared nursery beds during August-September or March-April. After four to five weeks the seedlings are transplanted on ridges to facilitate drainage.

Transplanting is done in the spring or in the autumn. Care is taken in the autumn to transplant the seedlings firmly and deeply so that roots are not lifted up with frost that follows immediately after. Drizzling is observed to have very useful effect during transplantation periods and on the transplanted plants. Transplantation is also done in summer if seedlings are frequently watered.

Weeding operations are tended in the spring and the autumn and are very advantageous to the growth of the plant. The plant flourishes on well-drained soil; in fact waterlogging kills the pyrethrum plants[1].

The plant begins to flower in June and continues flowering till the end of July. Flowers are harvested when the disc florets are three-fourths open. These are generally hand-picked by numerous labourers and are dried in the sun on tarpaulins or mats for three days after which they are removed into shade to complete the rest of drying. Every care is taken to clean the dry flowers of foreign matter before they are put into bags and sealed. The bags are weighed at each plantation and despatched to the Utilization Divisional Godowns from where these are marketed.

Experimental work done at the Drug Research Laboratory

Since the cultivation of pyrethrum started on commercial lines steps to put the industry on sound scientific lines were also taken by the Kashmir Government. Series of experiments were conducted in the Drug Research Laboratory in collaboration with the Forest Department on different problems. Some of them are briefly summarized below:

(a) *Pyrethrin contents of different plantations:* Pyrethrum fields are scattered far apart from each other and vary in respect of climate, soil and heights. Each plantation therefore differs somewhat in its pyrethrin contents from the other. Table II gives the total pyrethrin contents of the flowers from some of the plantations analysed at the Drug Research Laboratory.

TABLE II

Pyrethrin contents of different plantations

Plantation ..	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII
Altitude ..	5000	5000	6000	5500	8000	5000	5500	5600	6000	7000	8000	6300	7000
Percentage of total pyrethrins ..	0·95	0·96	1·01	1·02	1·00	0·84	0·87	0·75	0·98	1·01	0·99	0·94	0·94

Note: The average moisture content of the dry flowers ranged from 8 to 9 per cent.

(b) *Effect of altitude:* Table III indicates that whereas pyrethrum can profitably be cultivated at altitudes of 5,000 ft. to 8,000 ft. above sea-level, an altitude of 6,000 ft. represents the optimum height for the cultivation of this plant in Kashmir with a view to obtain the highest yields of pyrethrin.

(c) *Method of drying:* Series of experiments were conducted to investigate the best method of drying pyrethrum flowers under natural conditions. Samples of flowers were collected

TABLE III

Effect of altitude on the pyrethrin contents

Plantation	I	II	III	IV	V
Altitude	5000	5500	6000	7000	8000
Percentage of total pyrethrins	0·95	1·02	1·1	1·01	1·00

Note: The average moisture content of the dry flowers ranged from 8 to 9 per cent.

[1] Fotadar, M. R., *Current Science*, Vol. 9, p. 360, 1940.

from plantations situated at different altitudes and were subjected to drying by the following four natural methods :

(A) Drying in sun.

(B) Drying in shade.

(C) Drying in sun for three days and then completing the rest of drying in shade.

(D) Keeping in sun for seven days.

From, the perusal of the data given in Table IV it will be observed that total pyrethrin contents are highest in the case of flowers dried for three days in the sun and rest in shade.

The method of drying in shade is also a lengthy one and can be only restored if weather conditions are bad. It appears, therefore, that the best method of drying pyrethrum flowers under the climatic conditions here is to dry them for three days in the sun and to complete the rest of drying in shade.

TABLE IV

Drying of pyrethrum flowers under natural conditions

Plantation	Method of drying	Percentage loss of moisture on drying	No. of days required for drying	Percentage of moisture present in dry flowers	Percentage of pyrethrin contents
I	A	72·5	4	9·7	0·94
	B	73·7	11	10·4	0·95
	C	72·5	6	8·4	1·01
	D	72·5	4	8·3	0·92
II	A	72·5	4	9·0	0·98
	B	73·7	11	10·2	0·97
	C	73·7	6	10·1	1·00
	D	72·5	4	8·1	0·93
III	A	75·0	4	9·3	0·94
	B	73·7	11	10·6	0·95
	C	76·2	6	8·8	0·99
	D	76·2	4	10·6	0·93
IV	A	78·1	4	8·8	1·04
	B	77·0	11	9·8	0·99
	C	75·0	6	8·7	1·04
	D	76·2	4	9·0	1·02

(d) *Effect of age of the plantation*: An examination of the flowerheads in respect to the age of the plantation reveals a gradual fall in the active principle content from year to year. This is probably due to the exhaustion of soil. The conclusion of Chopra and others[1] have been confirmed in Table V.

TABLE V

Effect of age of the plant on the pyrethrin contents

	Percentage of pyrethrin contents for				
	1st yr	2nd yr	3rd yr	4th yr	5th yr
Plantation I : Altitude 6500 ft.	1·05	1·03	0·98	0·94	0·97
Plantation II : Altitude 8000 ft.	1·05	1·04	1·02	1·01	0·98

Note : The average moisture contents of dry flowers range from 8 to 9 per cent.

(e) *Number of flowers per plant*: In some of the pyrethrum plantations plots were laid out for counting the number of flowers on each plant. The results are tabulated in Table VI. The plants were divided into three categories, viz. heavy, medium and low, according to the yield of flowers. The maximum number of flowers recorded is 382 while the minimum is recorded four only. In another plantation the maximum record of flowers in one plant was 714.

The heavy yielders if selected for seed only may ultimately prove of advantage in improving the yield of flowers per acre which is at present about 4 md. against 8 md. recorded in Kenya, Japan and other places.

TABLE VI

Average number of flowers

Type	No. of plants examined	Average No. of flowers per plant	Range of flowers per plant	
			Maximum	Minimum
Heavy	50	241	382	101
Medium	50	126	203	70
Low	50	13	45	4

(f) *Development of flowers and harvesting time*: It is an established fact that the flowers

[1] Chopra, I. C., Dhar, M. L., Handa, K. L., Habibullah, M., Assa Nand, P., *Current Science* Vol. **14**, p. 104. 1945.

should be collected when the disc florets are three-fourths open. It has been shown by Chopra and co-workers that pyrethrum flowers growing in Kashmir conform to the general rule. Their results indicate that pyrethrin contents tend to increase from the closed to the open stage. But when the flowers are fully open this percentage shows a decrease. This is obviously caused by the increase in weight of the flowerheads which follows pollination, and the subsequent formation of the seeds. This latter growth results in an increase of nearly 60 per cent in the weight of flowerheads[1].

Animals and insects pests

It has been observed that pyrethrum plantations on higher altitudes—6,000 to 8,000 ft.—are greatly damaged by rats. The rat has been identified by the Zoological Survey of India as *Microtus* (*Alticola*) *roylei* (Gray). It resembles very closely *Microtus montosa* (True). The damage wrought by this pest cannot be accurately calculated but it is in the neighbourhood of 1,200 to 1,500 md. of pyrethrum flowers annually. Indeed the loss appears even more than estimated.

Generally the two-year old plantation is attacked. The damage occurs during the autumn and winter when there is no other food for the rat. The pest burrows into the ridges on which the pyrethrum plants are transplanted to facilitate drainage. This system of planting on ridges is very good from cultivation point of view but the rats find a good shelter in these and are able to inflict considerable damage to the plant.

So far local indigenous methods of controlling this pest have failed. Experiments to control this rat with different chemicals and other biological controls are in progress, and will be communicated in due course.

Recently an insect pest was also detected eating the root of some plants resulting ultimately in their drying up. This insect pest was collected from one of the plantations. The insect was collected in its larval stage and has been identified by the Forest Entomologist at Dehra Dun to be the larva of *Melolonthinie* of the family Scaraboeideae. It is one of the beetles whose habit is to feed upon or cut the roots of the plants. Fortunately it is not a widespread pest and measures are being taken to control it before it can do considerable damage to the crop.

Marketing

After the First World War, Japan became the principal exporter of pyrethrum in the world market and in 1935 maximum output was 12,500 tons. In 1933 Kenya began commercial production and is now the second largest producer with an output of nearly 2,000 tons in 1938. Brazil is the most recent newcomer to the pyrethrum export market and its produce in 1938 was 250 to 300 tons[2]. The total world production of pyrethrum flowers is over 15,000 tons and America is the biggest consumer[3].

India has been importing pyrethrum flowers from Japan and Kenya till recently. During the Second World War the supplies from Japan were cut off and those from Kenya were restricted.

Kashmir has been supplying the pyrethrum flowers to the Government of India during the war when the foreign supplies were inadequate. Although the quantities of flowers supplied were far too small for the total amount required for consumption, it did help to meet to some extent the military requirements during the war.

During 1941-42 when the Kashmir Government decided to expand the cultivation of pyrethrum on commercial lines under a special Pyrethrum Officer, the yield of flowers in the following year (1942-43) was about 336 md. as against 28 md. during the previous year (1941-42). Still more area was gradually added to the existing pyrethrum area and the yield of dry flowers in the year 1943-44 was 1,468 md. The crop suffered from the inclement weather conditions in the following year and the output in 1944-45 was not more than 1,436 md. in spite of more land under the crop than before.

During 1945-46 however the crop yielded a better harvest and the yield has gone up to 2,200 md. The present crop would be released for civilian use in India now.

The acreage under pyrethrum outside Kashmir in British India is less than 2,000 acres and the

[1] Chopra, I.C., Dhar, M.L., Handa, K.L., Habibullah, M., Assa Nand, P., *Current Science*, Vol. **14**, p. 104, 1945.

[2] Holman, H. J. *A survey of insecticide materials of vegetable origin.* Imperial Institute, 1940, London.

[3] Gnadinger, C. B., *Pyrethrum flowers.* 2nd Ed. with supplement, 1936.

area is being increased in Nilgiri Hills, Assam and Mayurbhanj State. Kashmir pyrethrum has already established itself in India and its insecticidal properties compare favourably with the imported commodity. It is, therefore, suggested that in spite of all the competition the Kashmir pyrethrum will have a great demand in Indian markets. There is in view an ambitious scheme for extending the cultivation of pyrethrum in available open land in forest areas and poor quality of land from point of view of growing food and fodder crops.

As stated before the land under this crop at present is approximately 2,100 acres. The scheme envisages to add more acreage annually till it reaches 8,000 acres or so. If everything goes well, the total yield of pyrethrum flowers may be increased from 500 tons to 1,000 tons during the course of five to ten years.

Recently, when the Central Government Planning Committee met to consider the post-war requirements of India, pyrethrum was discussed and it was revealed that the annual requirements of pyrethrum flowers will be 4,000 to 6,000 tons and were likely to increase to ten times this figure in the course of the next 15 years.

Conclusion

Pyrethrum industry, therefore, appears to have promising future as the source of much-needed vegetable insecticide in this country, both for destroying vectors of disease and plant pests. Pyrethrum has the advantage over synthetic insecticides in being instantaneous in action and non-injurious to human beings, livestock and plants infested with pests. It will readily find its commercial application in agricultural and horticultural domains as a useful remedy against the insect and other pests.

PYRETHRUM, ALSO ROTENONE, RETURN

ALTHOUGH DDT has proved such a powerful agent in the control of flies and insects, pyrethrum and rotenone, the two well-known substances used in agricultural and domestic sprays, have by no means been supplanted. They were practically munitions of war and were in short supply for civilian use during hostilities. Supplies are now on the way to regain their normal position in the trade.

Pyrethrum, variously known as Persian Pellitory and Dalmatian flowers according to their place of origin, came originally from Dalmatia, in Yugoslavia, but after the First World War the trade was monopolized by the Japanese. Later a high quality flower was developed in the British Kenya Colony in Africa, and during the Second World War a source of supply was developed in South America. At the present time, Kenya supplies are coming forward and, with the anticipation of a good crop this year, it is expected that the position will soon be about normal.

Rotenone, which is derived from derris, sometimes called tuba, originates in the East Indies. It is also obtainable from cube and timbo which grow in South America. Now that the war is over, East Indian supplies are once more obtainable, but they are going mostly to the British Isles. The South American supplies are more or less confined to the American continent, and, now that government control has been lifted, are once more in the hands of the trade. Rotenone is a powerful ingredient in sprays against biting and sucking flies and other insects, and is particularly effective against warble grubs, from which warble flies emerge.—*Dominion Department of Agriculture, Ottawa, Canada, Farm News* No. 564, August 21, 1946.

CRUMB STRUCTURE AS AN IMPORTANT FACTOR IN SOIL EROSION

By R. V. TAMHANE

EROSION, the removal of soil by water or wind is taking place everywhere in India and a part of the wastage is obviously an immediate loss to the farmer—a loss almost beyond repair. Much of the wastage may not be an immediate farm loss but nevertheless it is certainly a loss to posterity and there are many indications that our increasing population may feel acutely the evil effects of this scourge of the land now largely unrestrained.

Erosion robbing fertility of land

The failure of our Indian soils to give higher yields is not only due to the continuous cropping and low fertility of soil, but also due to the wearing away of the top-soil. It has been estimated by American workers that the loss of plant food material in soil by erosion is more than 20 times the annual net loss due to cropping. Duley[1] speaking about erosion of farm lands says that most of the worn-out lands of the world are in the present condition because much of the surface soil has washed away and not because they have been worn out by cropping. To maintain, therefore, an acre yield of our soils at a point where crops can be produced at a profit we must make every effort to reduce the amount of fertility that is carried away by erosion. The Indian farmer in many instances does not know just what to do to slow down the erosion. He does not even recognize the fact that gradual erosion working unnoticed is the principal thief of the fertility of his land.

Erosion due to moving water occurs in two forms, sheet erosion and gully erosion. Small areas are particularly ruined by gullying while sheet erosion slowly carries away the very fertility of the soil. Besides this normal erosion occurring under undisturbed natural conditions, the American workers have attributed the erosion caused by man as 'extra' erosion superimposed on the 'normal' erosion.

[1]Duley, F.L., *Missouri Agric. Expt. Sta. Bull.* **211**, p. 23, 1924.

R. V. TAMHANE, PH. D. (LOND.) is Assistant Soil Survey Officer in the Indian Agricultural Research Institute, New Delhi.

Erosion losses

The effect of erosion is extremely variable from place to place on varying soil and varying slope, with varying vegetation cover and method of land uses. At Missouri Agricultural Experimental Station, it was found that on a 3·6 per cent slope nearly 41·2 tons of soil were washed from an acre of land ploughed 4 in. deep. At Texas it was 40 tons per acre on 2 per cent slope, and in North Carolina, the soil loss was nearly 25 tons per acre[2]. The experiments conducted in Bombay Presidency also show similar loss of soil which may amount to 40 tons per acre from clay loam having a slope of about 3 per cent with the average rainfall of only 23·5 inches[3]. It is computed that the cultivated surface layer of 8 in. thickness would be removed in a period varying from 20 to 54 years. The soil thus removed was found to be richer in all plant food material than the original soil. Thus, the factors contributing to the fertility of soil are lost permanently in a large proportion. The plant nutrient elements, that are removed by crops can be restored in the form of fertilizers, manures and soil-improving crops turned under but the soil that is once washed out of a field cannot be restored except by the exceedingly slow natural process of soil-building that requires centuries to develop a comparatively thin layer. It would be entirely impracticable for human being to replace even a small part of the eroded material in a few years. T. C. Chamberlin[4] observes that to form one foot of soil more than 10,000 years would be required.

Structural factors

Since there are several soil factors that influence the control of erosion and runoff, the ease with which water can penetrate a soil, and the methods to achieve this, are of primary importance. Methods of preventing erosion, therefore, must cause the water either to sink into the soil or flow away slowly over the

[2]Bennett, H. H. and Chapline, W. R., *United States Department of Agriculture Circular*, No. 33, 1928.

[3]Kanitkar, N. V., *Dry Farming in India*, 1944.

[4]Chamberlin, T. C., *United States Department of Agriculture Circular*, No. 33, 1928.

surface to a drainage channel. If all rain water were absorbed by the ground upon which it falls, soil erosion would be reduced to a minimum. To sink the water rapidly in the surface, the soil must be very permeable which means that it must contain fairly large open spaces through which surplus water can drain away but at the same time conserving a part of that absorbed for plant growth. This porous condition is obtained by creating a suitable structure, viz. crumb structure.

Crumb structure explained

Structure is the aggregation of the ultimate particles of soil into large compound particles. The colloidal material in the soil under certain conditions binds the soil particles together into aggregates or crumbs which behave in many respects as a single unit. In such a crumb or granule, the pore-space distribution is such that finer pores inside the crumb hold appreciable quantities of water available for the plant growth, behaving as water pockets, while outside the crumbs large pores and cracks help the surplus water to drain away freely, thus minimizing the surface runoff to a great extent. A granular soil will not only absorb, more water earlier than the other in a non-granulated state, but will also hasten the percolation. The dispersion, i.e. the slaking of soil particles to form a suspension, is little in such soils with the result that the soil does not get washed away or eroded so easily; whereas in a non-granulated soil, the individual soil particles are so small and so light that they are either blown away by wind or get dispersed easily in rain water and are carried away freely by runoff. It is obvious therefore that the more difficult it is to disperse a soil particle in water, the less will be the tendency to erode. A granulated soil is fairly resistant to dispersion and consequently to erosion as well. The degree of aggregation of a soil, therefore, plays a very important role in the erosiveness of a soil. It decreases the ease of dispersion and makes it more difficult to go into suspension. The size of particles is also increased so that a higher velocity of water and wind is required to transport the soil. Hence the surface of a soil subject to blowing, like many of those in the drier parts of the country, should always contain a large percentage of bigger crumbs that will protect the fine material.

In a poorly structured soil (single-grained structure as against compound structure) the small particles are either un-aggregated (loose) or packed tightly into a structureless mass leaving only minute spaces between them for the rain water to percolate. Rain water then either washes away, quickly carrying away the loose soil particles or penetrates with great difficulty into the structureless mass and only a few surface inches are quickly saturated and the bulk of the rain then runs off eroding the surface as it goes. The greatest harm of an excessive soil erosion is the removal of a surface soil and the exposure of a lower horizon of poor structure. The subsoil of many soils is so lacking in granulation, is so massive, especially when exposed at the surface, that it is almost impossible by any practical means to attain a structured soil suitable for crops.

How to get a crumb structure

To get a granular or crumb structure, a soil must possess certain properties. It must have enough colloidal material to bind the particles together without which they fall to pieces as the sand does. Then, it must have enough organic matter and lime. The beneficial effect of lime is to hasten the decomposition of organic matter needed to cement the clay particles. Cementation of clay particles is the most important mechanism enabling mineral soil to form crumb structure. Although the exact mechanism of crumb formation is not yet completely understood, it is known that clay particles at lower moisture get themselves arranged and adhere to each other with the help of organic colloids and calcium salt to form a granule, which maintain its form firmly. Cultivation at proper time also influences the structure. The soil must be cultivated at proper moisture content. If the soil is too wet it will get puddled and form big clods, but if too dry, it will fall to dust. If cultivation is done at proper moisture content it will get into proper structure. Thus the inherent factor to control erosion is the property of a soil to build a suitable structure.

Other control measures

However, structure is not the only means to check erosion. The other methods of soil conservation, which have been found effective in slowing down or controlling erosion, are the terracing of the land, the growing of trees, grasses and other soil-holding plants.

One method of reducing erosion from cropped area which has been much taken up in the

United States is strip cropping, i.e. growing different crops in strips along the contour so that the cumulative surface-wash from a very vulnerable crop can be reduced. Besides this, the acceleration of erosion is caused greatly by unwise land utilization, which also destroys the structure. Wise land use applying the full use of vegetation to protect and to build structure is the real solution.

In India, however, the problem is not so simple. Every acre owner should try to save rain water as much as possible since a relatively small area of our country receives sufficient rainfall to maintain intensive agriculture. If this rain water is allowed to run away, carrying with it the cream of the soil, the loss would indeed be irreparable.

To know and to make use of the proper measures of protection, we must know our soil correctly. No programme of soil and water conservation, therefore, can expect to be successful without an adequate survey of our soils to classify them into different categories and capabilities of proper land use.

IMPROVING HUMUS CONTENT OF SOILS

SPEAKING generally, the soils of the Maritime Provinces are naturally low in humus. During the war years many farmers have failed to follow recognized farm practices, due to the need of greater production. This has resulted in the serious depletion of humus in the soil and there is evidence, particularly in the specialized crop areas such as potatoes and strawberries, of serious soil erosion taking place, says Dr C. F. Bailey, Superintendent, Dominion Experimental Station, Fredericton, N.B.

In an area in New Brunswick where strawberries are being grown extensively, the majority of the growers have had crop failures in recent years. The most successful grower of strawberries is a farmer who relies largely upon barnyard manure for maintaining soil fertility. Like most of the growers in that area, the common practice is to grow potatoes on the same land four or more years in succession, to be followed by strawberries, sometimes preceded by beans. In the case mentioned the rotation of crops followed was not one to be recommended as it embraced growing potatoes continuously four years, followed by strawberries. However, each crop of potatoes was fertilized with approximately 20 tons barnyard manure per acre and the strawberries received a much heavier application of manure. While the rotation followed leaves much to be desired the annual application of barnyard manure resulted in the humus content of the soil being well maintained. Several of the other growers in the district have adopted much the same type of rotation except that they have added a crop of beans to follow the strawberry crop. These growers have been depending largely upon commercial fertilizer supplying only a limited amount of barnyard manure to their land under cultivation. Samples of soil taken from several of these farms for analysis were found to be seriously lacking in humus. Extreme cases such as these are fortunately rare and it can be said that most potato growers in the recognized potato areas of the Maritime Provinces try to follow the modern methods of cultivation. Generally speaking, a somewhat elastic rotation is adopted, depending somewhat upon the acreage of potatoes under cultivation. These growers are not maintaining the number of livestock they should on their farms and in many cases the acreage in potatoes is much too large to provide sufficient humus through the use of barnyard manure.

In recent years the use of ground limestone has done much to encourage the growth of clover in potato-growing areas. This will no doubt result in helping to maintain the humus content of potato soils. In view of the importance of maintaining the humus content of soils, the question of soil fertility merits greater attention, otherwise soil productivity will become even more seriously reduced and erosion will cause even greater depletion of soil fertility. —*Experimental Farm News*, issued by Department of Agriculture, Ottawa, Canada.

SOME ASPECTS OF MAN-MADE SOIL EROSION AND CONSERVATION FARMING

By P. V. C. RAO

AN average Indian peasant endeavours to extract the maximum possible yield from his holding by means of primitive cultural practices, and when he finds himself unable to make both ends meet with the returns, he heaps up encumbrances on his rights to the holding which ultimately passes into the neglected estate of an absentee-landlord creditor. Now the peasant becomes the tenant and he intensifies the exploitation to meet his own and the landlord's demands, with no permanent interest in the well-being of the land. This kind of speculative economic interest in the land has been responsible for its degeneration and consequent exposure to wind and water erosion.

Protective and destructive systems of farming

Under certain conditions some types of agricultural practices lend themselves to soil maintenance, while other systems are conducive to soil depletion. A system of farming that keeps the land in continuous cultivation is a destructive system, since very often it does not provide for a return to the soil of much-needed humus and plant nutrients. This is particularly true on land that is rolling or hilly and for this reason subject to erosion. On the other hand, a system of cultivation that keeps much of the land under cover, such as trees and grass, is protective and also conducive towards the enrichment of the soil. But the various systems of farming that by their very nature are soil-conserving cannot be adopted as a whole everywhere.

Pasture and close-growing crops such as hay and small grain protect the soil admirably well against erosion. Dairy-farming systems are well-adapted for this purpose and are quite profitable near the urban areas. But more than often due to want of organization in dairy-farming, there is a tendency to overgraze the pastures resulting in the extermination of forage crops and waste of animal manure.

P.V.C. RAO is a Corporate Member of the American Society of Agricultural Engineers. In this article he has dealt with erosion of soil as caused by farming practices.

Misuse of soil

In the heavy rainfall regions of the coastal belts, especially in the delta areas, rice is grown on an intensive scale without proper crop-rotation, and signs of soil exhaustion and gully erosion are apparent in many sections. The fact that crop yields are still relatively high in certain parts of the surplus districts is due largely to the original high productivity of the soil, combined with the use of fertilizers. The peculiarity with the difference in the natural fertility of the soils is that certain types of soils do not produce well from the start unless special attention is given to make them productive; others produce large crops for a short time and then rapidly diminish in fertility, while others known as 'strong soils', remain productive for many years without attention to their fertility. But even the strongest soils will wear out in time unless they are intelligently managed. It is due to such improper management and maladjustment of crops that even the best of the fields is becoming less productive. Steps for soil-rebuilding must be taken up in these areas, but not only are time and money required for this purpose, but during the process the returns will slightly diminish in the initial stage. Hence conservation methods are not possible to be adopted by individual farmers on their own initiative and most of them cannot afford the initial capital outlay with their debts and other obligations. Therefore, there is the invidious process of soil misuse, the result being lower yields, lower production and food-shortage.

Evil effect of producing cash crops

Another staggering feature is the incessant and exclusive growth of cash gain crops such as cotton and tobacco. In this system of farming, little vegetable material or animal manure is

returned to the soil, and due to the continuous rigorous extraction of plant food and the poor defence against runoff offered by these crops, the land becomes rapidly sterile and unproductive. This is how the once surplus districts of the Northern Circars are rapidly turning into deficit areas, and the lands of the arid regions of the Deccan plateau, which have already been badly mauled by wind and water erosion, are allowed to deteriorate still further by the destructive practice of exclusive cash-crop production.

Evil effect of deforestation

Instead of adopting measures to correct the existing wasteful farming practices and to reclaim the vast expanse of eroded and eroding land by conservation methods, the agriculturists are being encouraged to abandon their holdings in which the yields have fallen below the line of profitableness, and migrate to forest areas which are cleared and brought under cultivation. When the plains are already groaning under the agony of floods and runoff due to the barren hill-sides, it is a dangerous policy to reduce the forests any further in order to bring in a few hundreds of acres under cultivation. The first stage of soil misuse starts with the clearing of the natural forest and erosion sets in when the exposed land is subjected to indiscriminate and intensified cultivation. In this respect, the hilly regions are more vulnerable than the flatter surfaces.

Uneconomical farming of small holdings

Unfortunately, in our country the holdings are fragmented to such an extent that in numerous instances establishing a system of farming with individual farms as separate entities, that will conserve soil and produce a desirable family income, is extremely difficult. The idea of a small farm and economic independence is too often a myth except under very favourable circumstances. Exceptions are to be noted for certain types of small farms devoted for fruit and truck-crops and poultry breeding. But, such types are restricted in number and suited only to some favourable sections of the country. Obviously, the destructive cropping systems may be in use on large as well as small holdings. But small farms of any type, especially when subjected to continuous cultivation of soil-depleting cash crops, are less readily adjusted to conservative farming than are the larger farms. The more economical and effective operations possible on the large farms are impossible on the smaller ones in which the labour is inadequately employed, the equipment is expensive in proportion to the area handled and the total production, resulting in inefficiency and low income.

Remedy

The situation can be remedied only by consolidation of holdings into economical units and cooperative farming. But, these measures should not preclude or necessarily precede State action in the enforcement of essential conservation practices on a mass scale irrespective of the extent of individual holdings.

Problem of farm tenancy

Farm tenancy is yet another problem affecting land-use practices. Absentee or non-operating farm ownership and the tenancy often cause the tenant and sometimes the landowner to be interested only in the highest possible immediate income from the land regardless of its future productivity. Many landlords have a tendency to extract as much as possible from their lands every year and commonly select their tenants on the basis of the prospect they offer of raising the largest possible crop in the year immediately contracted for. Furthermore, they naturally endeavour to throw upon their tenants as much as possible of the repair costs. Essentially, the same policy is followed by landlords with good financial standing and with no particular dependence upon agricultural incomes. Tenants are allowed to exploit the land freely. Generally, over-cropping and specialization in the production of soil-depleting crops are characteristic features of tenant-farming.

The reason for the exploitative interest of the tenant is not far to seek. Farms are ordinarily rented for short terms without assurance of renewal; and renewals, if granted at all, are commonly withheld until harvest time, or until a few weeks before the expiry of the lease. With such short-term arrangements, a tenant has little inducement to apply himself and his capital for anything except short-term exploitative enterprises in which soil maintenance and improvement work have no part. The uncertainties of his occupancy and requirements of his lease dictate beyond any measure of

doubt what crops he can grow and what livestock he can keep to advantage. Hence, he is largely a producer of cash crops such as cotton and tobacco.

The argument that the tenant generally has informal assurance of renewal of his lease if he looks after the farm well has little value because he is often deprived of the fruits of the improvement made by his labour and investment, due to the land being let out at a higher rental to another tenant or sold out at a higher price.

The present leasing arrangements are outgrowths of customary practices designed for intensive exploitation of the land. In short, the leases have developed in such a way as to leave landlords free to sell the farms, tenants free to move and both free to exploit the soil indiscriminately. Neither landlord nor tenant has desired to accept any great responsibility towards the welfare of the soil, each taking only a transitory interest in its use in the quests for quick gains.

It is of the utmost importance that these mal-adjustments in the system of tenancy are put an end to, by means of legislative measures in order to save our agriculture from the throes of erosion and exploitation, by man as well as by nature.

SAND DRIFT CURE

LARGE-SCALE planting of rye corn has been suggested as a possible cure for wind erosion and sand drift in the Mallee areas of Victoria, Australia. The Premier, Mr Cain, following a tour of inspection, is to call a conference of the State Rivers and Water Supply Commission, the Lands Department and the Soil Erosion Board to evolve plans, when the rye corn suggestion will be considered.

The Mallee country has been Victoria's headache for many years. Over the past 20 years the average yearly cost of removing drift sand from irrigation channels has been Rs. 7,49,572. In the last financial year, just ended, it was Rs. 34,80,200.

Farmers would have to cooperate with the Government to end the erosion menace, Mr Cain warned.

The Mallee at present is exhibiting the recuperative qualities so remarkably characteristic of Australian land generally after drought. One Member of the State Parliament after a 150-mile trip has described the Mallee as "a veritable Garden of Eden". Crops are making remarkable progress and a very good harvest is expected. Grass is abundant and stock in first-class condition.

But the Mallee is only a part of Australia's larder. In western, north-western and north coastal areas of New South Wales the country is in the grip of another of the disastrous series of war-years droughts, endangering a quarter of the State's wheat, and slowly killing sheep and cattle.—*Australian Agricultural Newsletter*, Release No. AGN/138.

COTTON BOLL-WORM CONTROL BY GENES

OF the major pests of cotton, the three boll-worms (spotted boll-worms—*Earias insulana* and *Fabia*, and the pink boll-worm—*Platyedra gossypiella*) are most destructive, the total annual loss of *kapas* (seed cotton) yield being 30 to 60 per cent, and the loss in cash value of the crop to the cultivator running into crores of rupees. The Indian Central Cotton Committee soon after its inception interested itself in this important problem and financed generously many schemes, in Bombay, Punjab, United Provinces, Central Provinces, Hyderabad and Sind, for investigating the life-history of these pests, and working out control measures that would be within the reach and capacity of the ordinary cultivator.

The boll-worm is a very voracious eater and feeds indiscriminately by boring into young and old flower buds, and particularly the developing seeds of bolls. The destruction to the crop is mainly in the loss by shedding of these potential bolls. Besides this the quality and cash value of the *kapas* picked goes down considerably due to the presence of unclean *kapas* with tainted and immature lint. If the attack comes early in the season the crop maturity is very much delayed. The worms that are responsible for all this destruction are the larvae that hatch out of the eggs laid in hundreds on the plant by the moth. Of the various control measures tried, that of the clean-up measures in the off-season, the uprooting of all cotton plants and malvaceous weeds for the spotted boll-worm, and the heat-treatment of seeds to kill the pupae of the pink boll-worm are found to be the most practicable. Adoption of such measures to check the population of the pests was found to give a 20 to 25 per cent increase in yield.

There is yet another control measure so far unexplored by research workers—the introduction of hereditary (genetic) resistance or immunity to the boll-worms. All our cultivated cottons, *desi* or Americans, are susceptible to these pests, though the existence of differences between these of degrees of susceptibility and preference for a particular species of boll-worm have been recognized. The possibilities of selecting for resistance, even of a limited degree, within the species, is worth investigating. Meanwhile, increasing attention is now being paid to hybridization between species, especially since the discovery in 1937 of the remarkable alkaloid colchicine which is a new tool in overcoming sterility barriers that usually follow in these interspecific hybrids. It has definitely opened a new field of research to the plant breeders.

Cotton workers in India and elsewhere are paying increasing attention to the wild relatives of our cultivated cottons with a view to introduce from these such economically useful characters as resistance or immunity to diseases, pests and drought by transferring some of their hereditary elements or genes to the cultivated cotton. In the Cotton Genetics Research Scheme at Indore financed by the Indian Central Cotton Committee, particular attention is being paid to a wild cotton from Arizona and Mexico, *Gossypium Thurberi* (*G. trilobum*) having 26 chromosomes, the same number as found in the cultivated Asiatic cottons. It is a strange-looking plant with very small bolls and seeds and without any lint, so much unlike our cultivated cottons that it was considered some years ago as a different genus altogether, *Thurberia thespesioides*. This wild cotton has been reported already from various places and also found at Indore to be completely immune to the attack of all the species of boll-worms. It crosses well with our cultivated American and Asiatic cottons, and the resulting hybrid though it flowers profusely, is sterile due to lack of viable pollen formation. The chromosome number of its hybrid (26) with Asiatic cotton has been doubled by Harland, and Beasley in America through the use of colchicine and the resulting hybrid, which has 52 chromosomes, is found to

cross successfully with the cultivated Americans, also having 52 chromosomes. Similar hybrids have been successfully produced at Indore and some preliminary observations, on the boll-worm resistance of the hybrid were made. It is found that the tender shoot tips, young and old flower buds of both the undoubled and doubled hybrids are immune to boll-worms but the bolls of the doubled hybrid are found to be attacked. This problem of the exact mechanism of the immunity of the flowers is being investigated here. There are indications that immunity and susceptibility to boll-worms might be mainly chemotropic responses for oviposition of the moth due respectively to repellant and attractive scents given out by the plant, especially from the petals, a fact well-known in applied entomology. This problelm of immunity of *Thurberi* and susceptibility of the cultivated cottons has been studied elsewhere and various plant characters, such as non-hairiness of plant parts, smoothness and smallness of the bolls, and non-palatability of the seeds, have been supposed to confer resistance. The work on pest of wild cottons at Coimbatore has definitely proved that smallness of the boll at any rate has nothing to do with the immunity of *Thurberi*, as other wild cottons with even smaller bolls than *Thurberi* get attacked by boll-worms.

It is unfortunately almost impossible to transfer the complete immunity of *Thurberi* to the cultivated Americans through the synthesized doubled hybrid of *Thurberi*, because it will be difficult to eliminate the susceptible genes of the Asiatic component in the latter. This will be so because the 13 *Thurberi* chromosomes pair only with the other set of 13 *Thurberi* chromosomes and not with the Asiatic chromosomes, thus leaving no chance of the gene or genes for immunity crossing over from *Thurberi* to the Asiatic set of chromosomes. A more fruitful line of work would be to transfer the immunity first to Asiatics through the sterile undoubled hybrid by crossing this latter back to Asiatics. Though the chances of getting this back-cross are remote, every attempt is being made there to achieve this. Once such a transferred Asiatic is obtained by crossing this to *Thurberi* and doubling the chromosome number of this hybrid, the right sort of material for conferring the maximum of immunity to the Americans will become freely available.—(V.G.P.)

DDT FOR POTATO MOTH

EXPERIMENTS conducted by Mr N. C. Lloyd, entomologist, New South Wales Department of Agriculture, for the control of Potato Moth (*Gnorimoschema operaculella*) indicate that DDT is very much more effective than derris, which was the best insecticide previously available for this purpose.

In the spring of 1944 DDT was first used in small-scale replicated-plot experiments, with such good results that it was decided to investigate its possibilities further. In all subsequent experiments it proved superior not only to derris but to all other insecticides including 666 (benezene hexachloride) in controlling the pest in the foliage. At Milthorpe and West Maitland last year it was found possible to eliminate completely all breeding in the foliage within a month after commencement of applications.

In all these experiments the untreated plots were heavily infested. The material was equally effective whether used as 1 per cent or 2 per cent dust, or as 0·1 per cent spray. The results were obtained with knapsack spraying and dusting equipment with which the plants could be uniformly covered with insecticide. With power equipment it is more difficult to obtain a thorough cover.—*Australian Agricultural Newsletter*, Release No. AGN/135.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. I have heard of Brazil's 'wonder tree'—babassu (spelled 'babacu' by the Brazilians themselves). Can you furnish detailed information regarding this tree. As Brazil is more or less in the same climatic zone as India, was the question of planting the babassu tree in this country ever considered.—K.K.C.

A. The scientific name of babassu is *Orbignya Speciosa.* There is no mention anywhere of its having been grown in India. Macmillan in his book, *Tropical Planting and Gardening* does not mention this tree. In Brazil the plant is stated to grow wild and no efforts in the direction of planting or cultivation are apparently being made. The tree belongs to the palm family and grows chiefly in the States of Maranhao and Piaui. The babassu groves are stated to be very dense with about 500 trees per hectare of land (i.e. about 2·47 acres); half the trees however are unproductive. The annual yield per acre is between 500 and 1,800 nuts, with an average of 800. The method of harvesting is to pick up the nuts from the ground when they have fallen. The most common method of shelling, although many types of machines have been tried out, is by using the common axe which gives the best results. The oil content of the nut is stated to be 68 per cent and is used in Brazil for soap-making and the manufacture of vegetable fat. Recently some ripe nuts of the Brazilian babassu were obtained from South America for planting on Indian soils.—B.S.K. & J.R.K.M.

DRYING FRUIT BY SEARCHLIGHT

AN attempt is being made in Australia's Murray Valley—rich irrigation country—to dry vine fruits by searchlight, because dehydration plants cannot cope with the crop. Weather conditions have drastically restricted the usual sun-drying operations.

A complete army mobile searchlight unit was rushed from Seymour military depot, Victoria, to Redcliffs, following a request from the Federal Minister for Agriculture, Mr Scully, to the Minister for the Army, Mr Forde. The experiment with searchlight drying is being conducted by officers of the Council for Scientific and Industrial Research, in cooperation with growers.

The estimated total Australian harvest of grapes has already been reduced to 70,000 tons by weather conditions. A normal harvest amounts to 105,000 tons, 90 per cent of which comes from the Murray Valley Of the 70,000 tons, 51,000 tons was earmarked for Britain, but only 40 per cent could be sun-dried.—*Australian Agricultural Newsletter*, Release No. AGN/130.

What's doing in All-India

BIHAR

B. N. SARKAR

DURING the quarter ending 30 June, 1945 rainfall was general throughout the province. The precipitations during April and May were above the normal while during June, it was subnormal for most parts of the province.

Harvesting of *rabi* crops was completed, also the threshing although it was frequently hampered by rains in several places. Due to the damage caused to the *rabi* crops on the threshing floor by frequent rains, the quality of the grains was very adversely affected and it is apprehended that there may be a scarcity of good seeds in the province in the coming *rabi* season. To meet this contingency, however, the Department of Agriculture has arranged, with the Punjab Government through the courtesy of the Food Department of the Government of India, to obtain 40,000 md. of good wheat seed for distribution amongst wheat growers in Bihar. Preparation of lands and sowing of *bhadai* and paddy crops continued.

Due to frequent showers during the hot weather, the sugarcane crop did well in spite of the interference with intercultural operations. Of the varieties planted, Co 453 appears to have done well. Amongst the Bihar seedlings, BO 10 and BO 11 are reported to be making headway. The Watch and Ward Service returns show a recurrence of the whitefly trouble in Shahabad district and steps are being taken to control this menace in the very beginning. The beneficial results from *Trichogramma* releases in respect of stem and root borer control were once again confirmed in the experiments laid out in Champaran under the auspices of the Central Sugarcane Research Station. It is obvious that, next to the release of resistant varieties, biological control offers the most easily adaptable means that the Department can put out for controlling the attacks of the pests.

B. N. SARKAR, O.B.E., is Director of Agriculture, Bihar.

The condition and prospects of all other standing crops remained fair.

'Grow more food' drive

This campaign has been receiving the best attention of the department. The Minor Irrigation Schemes started by the Department are making fair progress. The scheme comprises of sinking of wells, construction of bunds, pynes and tanks. The Government subsidize such schemes (entailing a maximum total cost of Rs. 3,000) to the extent of 50 per cent of the total cost. The results achieved till May 1946 are:

No. of schemes sanctioned	7913
No. of schemes completed	3654
No. of schemes under execution	1299
Estimated area benefited	690,000 acres
Cost of completed schemes	Rs. 17,50,000

Exhibition and fairs

There has been of late considerable expansion in the publicity and propaganda activities of the Agricultural Department. Agricultural exhibitions and fairs are a regular feature of its activities. The Annual Fruit Show of the Bihar Horticultural Society held at Patna on 15 and 16 June last which was opened by His Excellency the Governor of Bihar in the presence of a distinguished gathering including the Hon'ble Minister of Development was a great success. Despite the general failure of the mango crop this year, exhibits of excellent qualities belonging to no less than 60 varieties were presented from various parts of the province. The Exhibition revealed the existence of at least 12 very superior varieties of mangoes in the Islampur—Bihar Sharif area not commonly known. Of these *Misri* (also called *Baddu-ka-Kelwa* or *Afzal-pasand*), *Misrikand*, *Mahboob*, *Safaida*, *Sabja* and *Benazeer* were considered to surpass most of the best-known varieties. Exhibits of fruits, fruit-products and nursery stocks were presented in 30 different

classes. Over 200 exhibitors participated. Cups, cash prizes and certificates were awarded in all classes of the Show which was greatly appreciated by His Excellency and the public.

Large-scale distribution of seeds and manures

In the beginning of the 'grow more food' campaign, large quantities of seeds had to be purchased by the Agricultural Department from farmers cultivating improved varieties of crops for supply to other cultivators needing the seeds. There was, however, no guarantee about the purity of the seeds or the uniformity of their quality. Recently, a system of registered growers has been introduced and rigid standards of quality for the purchase and distribution of Departmental seeds have been laid down. A start has been made with the scheme for multiplication of improved seeds of paddy through the registered growers and the distribution of the seeds to other cultivators requiring them. Without such a system of registered growers, it was beyond the production capacity of the existing Departmental farms to meet the ever-increasing demand amongst growers for superior seeds. Under the scheme, pure farm-grown improved seeds of paddy are supplied to growers of established reputation who take interest in their work and who agree to register themselves with the Department as its recognized agents for multiplication and supply of improved seeds. They are required to furnish a cash security of Rs. 50 and are required to apply on the prescribed form. The pure seeds are supplied to them on cash payment of its value or on credit to be realized at the time the produce is purchased back from them. They are required to keep the seeds supplied them pure, to grow and rogue the crop grown from it under strict Departmental supervision and control and to thresh the entire crop on a separate threshing floor. They have to supply the produce of the acreage for which they register (or at least ten times the quantity of seed supplied) in pure condition to the Department at market rates after harvest (between 1 January and 31 March) in addition to which the Department agrees to pay them a subsidy at the following rates: (a) Re. 1 per md. for the first 100 md., (b) Rs. 1-4 per md. for the next 100 md. and (c) Rs. 1-8 per md. for all supplies beyond 200 md.

This arrangement has resulted in considerable improvement in the quality of seeds. Out of 16,000 md. of improved paddy seeds recovered from registered growers during the last harvest, about 9,000 md. have again been distributed to registered growers, 2,850 md. have been handed over to the Cooperative Credit Agricole for distribution through their Departmental agency and 4,150 md. have been supplied to small growers on cash payment.

Since the launching of the 'grow more food' campaign, the Agricultural Department has distributed the following quantities of seeds:

1942-43	..	30,638 md.
1943-44	..	83,100 md.
1944-45	..	52,935 md.
1945-46	..	86,190 md.

The work of supply of manures to cultivators has now been taken up by the Credit Agricole Section of the Cooperative Department which is doing very good work in this direction. Between March and May 1946 alone, the quantities of manures distributed were (1) oilcakes 20,390 md. and fertilizers 12,860 tons.

Extension of irrigation facilities

At the instance of the Hon'ble Minister of Agriculture, as an emergency measure, increased irrigational facilities were offered in the Ram Nagar and Manihari canals in Champaran to irrigate an additional area of 8,000 acres. With a view to persuade cultivators in this area to take advantage of this facility, the Government offered a subsidy of Rs. 5 for each additional acre (over and above the previous year's acreage) cultivated on this account and for this, a sum of Rs. 40,000 was sanctioned. This measure is estimated to bring in an additional production of nearly one lakh maunds of foodgrains in the province.

Beneficial measures under contemplation

The measures under this head under consideration of the Government are:

(a) Increasing the Government subsidy for Minor Irrigation Schemes from 50 per cent to 75 per cent of their total cost.

(b) To subsidize tube well installations for irrigational purposes to the extent of 50 per cent of their cost.

(c) Revival of the pre-war system of demonstration of the practical advantages of improved

seeds, manures, implements and improved methods of cultivation on cultivators' plots on a more elaborate scale.

Eleven-point plan of agricultural development

In introducing the agricultural budget in the Legislative Assembly of the province on 25 June, the Hon'ble Dr Syed Mahmud unfolded the outlines of his 11-point plan for agricultural development in the province. These 11 fundamental points are:

(1) To make agriculture in Bihar independent of the vagaries of the monsoon.

(2) To consolidate holdings by cooperative farming and by other means.

(3) To reclaim the waste lands.

(4) To undertake large-scale multiplication of improved seeds and distribution of seeds, manures and implements.

(5) To conserve and develop manurial resources such as cowdung, cattle urine, town-refuse, oilcakes, etc. and to launch a campaign of compost-making in villages.

(6) To undertake measures for control of plant diseases and pests.

(7) To develop cultivation of protective foods from nutritional points of view, particularly fruits and vegetables.

(8) To reorganize the scientific research on agricultural problems in Bihar.

(9) To intensify demonstration and propaganda for agricultural improvements.

(10) To develop agricultural education and training.

(11) To undertake measures for the improvement of agricultural marketing in general.

He also invited the cooperation of all members of the House to help him in carrying out this 11-point agricultural developmental scheme. For this purpose, he suggested the formation of a Provincial Agricultural Development Board in which each district would be represented by M.L.A. or M.L.C. wi h a few other experts in practical farming with the Minister-in-charge as Chairman, the Parliamentary Secretary (Development) as Vice-Chairman and the Director of Agriculture as a Member-Secretary of the Board. He also proposed to invite suggestions from all quarters for agricultural developments of the province covering the points mentioned in his speech and offered a cash prize of Rs. 1,000 for the best paper on the subject.

JAMMU AND KASHMIR

JIA LAL RAINA

DURING war days, the poplar and coniferous fuel wood was mostly used for the production of the shook for the military supplies. This adversely affected the fuel supply of the country and thus the price of fuel and timber shot very high. The Government and private fuel plantations were recklessly exploited. The large stretches of land that were once under such plantation in both the provinces of Jammu and Kashmir were converted into bald areas, now subject to serious damage of soil erosion. In order to check this national loss and to cover up these bald stretches of land and to build up future fuel resources, His Highness' Government, on the recommendation of the Director of Agriculture, sanctioned the tree plantation scheme.

JIA LAL RAINA, M.SC. (HONS.), is Entomologist to the Government of Jammu and Kashmir.

Arborday

To give the scheme of tree plantation a workable shape arborday on the same system as is prevalent in U.S.A. since 1865 and other foreign countries was suggested. This scheme was approved by His Highness' Government by issuing a proclamation to the effect. A day was officially appointed for the annual planting of trees by the cultivators, lumbardars, zaildars, students of colleges and schools and all other Government officers. Each individual had to plant a few trees. The day is to be recognized as a public holiday and will vary in different localities of Jammu and Kashmir according to the plantation season. This day in Kashmir Province was enjoyed with jubilation. Every one planted a few trees either in his private land or Government Khalsa land. The planters in Kashmir had an easy job to do. Simply the leader branches of willow and poplar were

removed and planted in very large numbers on roadsides, swamps and on the banks of rivers, nallahs, and rivulets. The planters did this not only for the love of the work, but with the hope of sharing the profits on 50 : 50 basis with the Government wherever such plantation was done in Government Khalsa lands.

The move in this direction made by His Highness' Government was not simply based upon the production of the timber and fuel, as is being considered by most of the gentry in the city, but appears to have been designed to turn waste and poor pastures to better account, to provide shelter from wind and to stem the violence of the storms and to check the soil erosion.

From an economical point of view the regular afforestation on such fixed arbordays, an annual function now, will raise the national wealth of the country in general. A willow and a poplar plant when once it takes the root, develops in a very short period. In about a decade from the date of plantation a willow will be ready for removal. At the end of this period it will serve as fuel or will provide wood for bat industry with commendable returns. Not only that, in the intervening period on every second year it will give an ample quantity of the loppings—a very important fodder for the sheep. Under the present condition Kashmir alone has about eight lakhs of sheep and if the fodder is increased it is sure to raise the number. This increase in the number of sheep will produce more farmyard manure and this in return will improve the condition of the soil and will make it more productive.

Kashmir fruits

As in last year the Department of Agriculture remained very busy in organizing the fruit supply to the Military Department. This year the fruit was graded, sorted and packed in Kashmir and then directly despatched to the various centres in and outside British India by the Royal Indian Army Corps. The system of grading was very much organized on the recent methods of technique. At each centre a big area of land was enclosed and covered. The suppliers were allowed entrance with their fruit on one side and the sorted and graded standard packages of fruit came out from the other side, where these were weighed, sealed, labelled and despatched. In all about 1,25,000 cases weighing about 70,000 md. net fruit of apples of different sort were graded and despatched. All this fruit was individually wrapped in paper and the army personnel supervised this work at all the working centres.

Entomological work

During the winter season the Department of Agriculture remained busy with the control of insect pests of fruit trees. Spraying was conducted on all the deciduous fruit trees against San Jose scale and Woolly aphis insects. The season throughout remained dry and offered a good opportunity to the entomological workers to attend to the maximum work. In all about a million fruit trees including the nursery plants were sprayed. About 32,000 gallons of diesel oil 'A' and 11,000 lb. of fish oil soap were used as insecticides.

Rationing of the diesel oil 'A' was a tough job to attend. Great difficulty was felt by the Departmet of Agriculture, in meeting the greater public demands. Every effort was made to distribute the oil proportionately on a fixed scale, but with all that the total quantity available was not sufficient to meet the increasing demand. Many orchards remained unsprayed. These unsprayed gardens will have to be attended to by the Department in the summer months when fresh supplies are expected (summer quota). The summer spray consists of lighter doses of the insecticides, and simply serves as a temporary relief. It saves the fruit from the specks only and does not cope with the progress of the insect on the remaining plant tissues.

Aphis brassica made a threatening appearance this year on the English vegetables. Almost all the growers rushed to the Government Entomologist for help. The use of fish oil soap 2 to 3 chattacks to a gallon of water was recommended. Free machinery was supplied to all these growers for spraying the insecticide. In almost all the fields infested with the aphis the control measures were applied with great success.

'Grow more food' campaign

The importance of the 'grow more food' campaign was very well realized by the people of Jammu and Kashmir. Large waste land areas and even the land under flower gardens

and green-sward at some places were ploughed and brought under crops, especially maize and potatoes. This voluntary sacrifice on behalf of the public will put in the market many a thousand maunds of maize and potatoes and will thus save the lives of many starving men.

District work

To eliminate cross pollination in the English vegetables raised for seeds, it was considered essential to isolate the various strains of the same crop. As such these strains were cultivated at great distances from each other. The Department of Agriculture was very busy in attending to it and every effort was made to make the scheme a success. The Department has succeeded in avoiding cross pollination and it is hoped that the seeds that will be supplied to the Indian market will be pure and true to the type.

Regarding the distribution of the improved seed, wheat Ford IP14, IP120, Marshel No. 3, were distributed to selected growers for seed multiplication. Chinese rice has proved to be a very high yielder and in almost all cases the yield has been doubled. This rice has demonstrated its quality without any further effort from the Department. All the rice cultivators are keen to obtain all the seed requirements from this type.

Agricultural shows

The Department of Agriculture took part in an annual function in the State Exhibition of 1945, held at the Exhibition grounds, Srinagar. Various types of fruits, vegetables—English and local—, paddy, wheat, etc. were exhibited. Insect pests of various fruit trees and crops were shown and their method of control explained. Apiculture and poultry farming were also demonstrated. The flower show too was arranged as usual. Large number of flowers of various sizes and hues were exhibited by the growers. After judging the same prizes were given to the best of the lot.

In the district a show was held at Shopian. There was a large gathering of the people who had rushed to the spot with their exhibits especially fruit. Lectures were delivered by the staff of the Agricultural Department. Cinema shows were also given. Later on prizes were given for the best exhibits.

TRAVANCORE

P. PADMANABHA IYER

TRAVANCORE produces rice only to the extent of nearly 40 per cent of her requirements. The deficit used to be imported from Burma and Siam. The area, suited to paddy cultivation, being limited by the peculiar geographical features of the State, great stress is laid on maximum possible production on scientific methods. Having regard to the repercussions of the world-wide famine conditions on the State, close on the heels of the cessation of hostilities, the 'grow more food' campaign, initiated by the Agricultural Department during the war, has been intensified and invigorated.

Bonus to cultivators

Special bonus will be granted to every cultivator, who will, within the next six to eight months, raise such crops as paddy, *ragi*, tapioca, sweet potatoes, yams and vegetables, on new land or land that had been lying fallow. The bonus will be paid at the rate of Rs. 10 per acre for cereals and tubers and Rs. 20 per acre for vegetables. A minimum area of 10 cents should be put under cereals and tubers and 2 cents under vegetables for entitling cultivators to the bonus. The crops will be conjointly inspected by the nearest Agricultural and Revenue Officers and bonus awarded on the basis of their recommendation.

P. PADMANABHA IYER, B.A., M.SC., is Biochemist, Compost Scheme, Travancore.

Minor irrigation works and subsidy for sinking wells

The Department of Public Works has been directed by the Government to execute expeditiously all urgent minor irrigation works within two months, suspending the normal activity,

with a view to enabling the entire staff of the Department to devote their time and attention to the works in question. A subsidy of Rs. 100 per well will also be given to ryots for sinking wells.

Distribution of manures and seeds

Arrangements have been made by the Agricultural Department for the speedy procurement and distribution of manures and varieties of seeds to ryots on a subsidized basis of $\frac{2}{3}$ of the cost price. Twenty lakhs of rupees have been earmarked therefor. Village Unions and Cooperative Societies will be centres of distribution, over and above the existing Departmental Depots.

The paddy cultivator is seriously handicapped by the difficulty and expense of getting a sufficient quantity of leaves for manuring his fields. The Government have therefore been generously pleased to direct the Conservator of Forests to arrange for the issue of free passes to bonafide cultivators (who own lands in the vicinity of reserve forests) for collecting and conveying green and dry leaves and leaf-mould from the contiguous reserve forests for a period of one year.

The post of the Bio-chemist, Compost Scheme, which had been lying vacant for more than one year, has now been filled up. Under the direction and guidance of the present Bio-chemist, 14 out of the 18 Municipalities of the State are manufacturing compost out of town-refuse and night-soil on a large scale. This rich organic manure is made available to ryots at a cheap price. It is proposed to grant bonus to the Municipalities concerned for augmenting and accelerating the production of compost. As soon as suitable sites are secured, the remaining four Municipalities will also start compost-making.

Distribution of selected paddy seeds and agricultural implements

A scheme for the multiplication and dissemination of pure and prolific strains of paddy raised in the Paddy Farm, Nagercoil, has been put in operation in Nanchinad (South Travancore), which is a very important paddy-growing tract, popularly known as the 'granary of the South'.

Arrangements have been completed for the manufacture and sale of agricultural tools and implements to ryots at controlled rates. The timber required for making handles, etc. will be given at nominal prices by the Forest Department.

'Grow more food' campaign

A Special Officer for coordinating and speeding up the measures described above has been appointed. All the Agricultural Officers have been enjoined to carry on, with unflagging zeal and enthusiasm, intensive propaganda for persuading ryots to bring every bit of land under food crops. They have also been directed to ascertain the extent of cultivable lands, lying idle, and to promptly bring to the notice of the Department of Public Works Officers the minor irrigation works which demand immediate attention. About 10,000 acres of lands from Reserve Forests have been given on lease to enterprising cultivators for growing food crops. The period of leasing out the premises of Government Offices, exceeding half acre, for the cultivation of food crops like tapioca, has been increased from one year to three years. The water-free portions of irrigation tank-beds have been leased out to ryots for raising vegetables during the hot season.

The Durbar has sanctioned two lakhs of rupees for developing deep-sea fishing and curing fish on up-to-date methods.

A fruit farm has been opened in the High Ranges recently for demonstrating the cultivation of suitable varieties of fruits, potatoes, and vegetables and for raising and distributing seeds and seedlings thereof among ryots. It is also proposed to lease out to bonafide agriculturists, for a long period, *poramboke* lands, situated in the neighbourhood of the Farm and suited to the cultivation of fruits, potatoes and vegetables.

Electric lift irrigation project

Under the Electric Lift Irrigation Project in North Travancore, 1,000 acres of single-crop paddy lands, situated on the banks of the Periyar, the biggest river of Travancore, have been converted into double-crop paddy lands. More lands will be brought under the Project as soon as the necessary motors, ordered from abroad, arrive. A Central Manure Depot has been established at Alwaye, a rapidly developing town, on the banks of the Periyar, for catering to the manurial requirements of the ryots of the Lift Irrigation tract.

With the financial support of the Travancore Durbar, a big factory, named Fertilizers and Chemicals, Ltd., is nearing completion at Alwaye for the production of fertilizers like ammonium sulphate on a huge scale.

Backwater reclamations

More than 15,000 acres of backwater-reclaimed lands in Kuttanad, (Central Travancore), which used to be cultivated with paddy only once in two years, have been brought under annual cultivation. There is a Special Officer at Alleppey, who sees to the equitable distribution of manures supplied from the nearest Departmental depot and to the putting up of bunds with clay and reeds and the timely and efficient baling out of water from the submerged fields prior to sowing—two vital operations on which the success of the cultivation of paddy in this region rests.

Control of prices of supplementary foodstuffs

To ease the present acute food situation in the State, the Government imposed restrictions on the export of supplementary foodstuffs, such as eggs, fish and bananas. By doing so it was hoped that the prices would come down, so that the articles would be within the reach of the public. Since the prices did not come to normal, the Government have issued a caveat to the dealers and producers concerned, that they would be constrained to fix the maximum price in respect of these commodities and enforce it by prosecutions for infringement.

Rural rehabilitation

An annual recurring grant of 1 crore and 10 lakhs of rupees has been provided for rejuvenating all the villages of the State in 10 years. There are 7,000 villages in Travancore. An Advisory Committee, consisting of nine members, (5 from among the non-official members of the Legislature and 4 from the official members nominated by the Government), has been constituted.

A 10-year plan under the Post-war Reconstruction Scheme has been inaugurated for the emancipation and elevation of backward communities. A recurring annual grant of 3 lakhs of rupees has been provided. An Advisory Committee consisting of Departmental Heads, representatives of organizations of backward communities and other organizations, interested in the uplift of backward communities, has been formed. The Travancore Durbar confidently hope that, at the termination of ten years, backwardness would be wiped out and that there would be no community in the State, to which the opprobrious appellation of 'backward' could or would be appended.

The scheme, adopted by the Government for the further development of Sachivothamapuram, a colony for backward communities, named after the Dewan of Travancore, Sachivothama Sir C. P. Ramaswamy Iyer, provides for both collective ownership and collective working of land. It approximates to the joint-family system, without the evils of the said system. The organizers of the Co-operative Society, guided by the Agricultural Inspector, lent by the Agricultural Department, apportion the tasks of the colonists and assess the value thereof and enforce their decisions. The scheme bids fair to become a shining success.

Ten ex-military officers of intermediate grade were given training in scientific agriculture at one of the Departmental Agricultural Schools, with a view to utilizing their services for training up a large number of demobilized soldiers, to whom lands are proposed to be assigned by the Government. It is hoped that these men will beat swords into plough-shares and bring a large area under cultivation. Their outlook, broadened by seeing a big slice of the world and the qualities of endurance, resourcefulness, self-reliance, working in a team and submitting to cast-iron discipline, which they have acquired in their active military life, will stand them in good stead and will tend to dispel the inertia, fatalism, conservatism and discord of the ryot population in the neighbourhood.

Raising tapioca hybrids

Remarkable progress has been made in the tapioca farm, attached to the University, which has now 72 varieties registered and where nearly 1,000 intervarietal hybrids have been raised. The evolution of reliable hybrids, having short duration and giving high yield, will revolutionize the cultivation of tapioca, 'the poor man's food'.

Activities of the economic development

The Secretary of the Board was also made the State Rural Reconstruction Officer. The

members of the Board met once during the quarter under consideration and discussed such important economic problems as increased production of milk, establishment of model agricultural farms in every taluk, provision of lands to the landless, popularization of balanced diet, welfare of labourers in factories and organization of canteens in industrial concerns.

Reorganization of the veterinary section

Dr T. W. Millen, B.Sc., M.Sc., D.V.M., Head of the Department of Animal Husbandry and Dairying, Allahabad Agricultural Institute, was invited by the Travancore Durbar to the State and requested to prepare a scheme for the reorganization of the Veterinary Section of the Agricultural Department. He duly visited Travancore and drew up a scheme, which has now been implemented. The salient features of the scheme are described below:

(1) An Assistant Director of Animal Husbandry and Veterinary Services should be appointed. He will be in charge of all the livestock development work and of the Veterinary Section.

(2) An Investigation Officer should be appointed. His duty will be to superintend the detection and eradication of infectious diseases. He will also be in charge of the Trivandrum Diagnostic Laboratory.

(3) A Technical Assistant should be maintained at the Public Health Laboratory to look after the preparation of veterinary biologics.

(4) Three itinerant veterinarians, one for each Division should be responsible for stamping out outbreaks of infectious diseases, collecting samples to be sent to the diagnostic laboratory and for the testing of cattle in selected areas for the detection of Brucellosis, bovine tuberculosis and Johne's disease.

(5) Three Livestock Development Officers should be appointed, one for each Division. These men should be graduates in Agriculture with specialization in Animal Husbandry and Dairying. Their duties would be prescription of diet for the stud bulls owned by the Department, preparation of silage in all silage depots, supervision of distribution of White Leghorn eggs in the Division and the organization of propaganda.

(6) All the veterinary surgeons should be trained in the work of improving livestock by artificial insemination.

(7) All private practice by Departmental veterinarians should be forbidden.

(8) The Government should subsidize a campaign for including minerals in the diet of Travancore cattle.

WORLD FOOD CRISIS MAY LAST FOR YEARS

THE critical world food situation may last for four or five years. Ample evidence exists to show that, even with the average or better than average yields for the remainder of 1946 and 1947, the world food situation will remain critical, at least until the harvests of 1947. Sir John Boyd Orr, Director General of Food and Agricultural Organization, has stated that the world food situation is likely to remain critical in one way or another for the next four or five years, and has urged some agreement on a plan for international agricultural action over that period of time.

The grain supply outlook for the approaching season is anything but reassuring, states the Monthly Review of the Wheat Situation. A preliminary estimate of world food needs and supplies for 1946-47, prepared by the FAO, reveals that in the case of wheat the import needs of the deficit countries may be as large as 30 million metric tons in order to maintain a minimum subsistence. On the other hand, assuming average weather conditions, the amount available from the "Big Four" exporters is not likely to exceed 20 million tons.—*Dominion Department of Agriculture, Ottawa, Canada, Farm News* No. 558, July 10, 1946.

SOVIET AGRICULTURE

ONE of the crucial features of the Russian planned economy has been the lag of agriculture behind industry. The expansion of farming under the three pre-war Five-Year Plans was impressive, when measured in absolute figures. But compared with the rate of industrial expansion, the growth of population and the need to improve the standard of living, it was modest. Up to a point the discrepancy has been natural and inevitable. Before the Soviets embarked upon the road of planned economy, agriculture predominated in Russia. Industry was still in its swaddling clothes. The scope for industrial growth was therefore much wider than that for agricultural expansion. The technical conservatism of the mass of peasantry was also, and to a large extent still is, a powerful factor to reckon with. But these reasons give only a partial explanation of the relatively slow development of Soviet farming. Another vital factor was the almost chronic antagonism between the regime and the peasantry, an antagonism which at times burst dramatically into the open, as in the period of forced collectivisation in the early thirties, and at other times remained sullenly underground.

Impact of collectivisation

The impact of collectivisation had at first a disastrous effect on farming. Roughly half Russia's cattle was slaughtered by the moujiks in revolt against the collectivist upheaval. Yet, between 1935 and 1940 Soviet farming was recovering from the shock, thanks to large-scale mechanization and also to a series of reforms that softened the rigidity of the original collective structure and gave the peasant a stake in the kolkhoz. Even on the eve of the war, however, the cattle stocks in the Soviet countryside were still much smaller than before the 'great slaughter'. And naturally the ravages of the war have once again thrown Soviet farming back—in some respects beyond the starting point of collectivisation.

New five-year plan

The new Five-Year Plan provides for the rehabilitation of agriculture on a large scale. The target figures for farming are very high, compared with the present plight of Soviet farming. Yet when the plan is completed, the discrepancy between industry and agriculture will still remain very marked. A few official indices illustrate this quite clearly. If the gross agricultural output for 1932 (the end of the first Plan) is put at 100, then the gross output for 1937 (the end of the second Plan) was 152, for 1940, 177, for 1950 and it is planned to rise to 225. In the discussions over the new Plan no comparative indices have been disclosed for the agricultural output in 1945 and 1946 and for the years of the war. Some fragmentary indications suggest that at the beginning of the first post-war Plan, Russia's agricultural output is probably not very much more than it was in 1932 after the great social crisis in the countryside. If this estimate is correct, then the Five-Year Plan is intended to bring about something like a doubling of output. Curiously enough, neither the Government nor the press has so far used such a comparison, possibly because of their reluctance to admit to the Soviet people and to the world outside that Russian agriculture has suffered a severe setback through the war. The official comparisons are made not with the present situation but with the last pre-war year. The increase of the total farm output in 1950 over that of 1940 is planned to be 27 per cent. However, just as in the industrial indices, the percentages for agriculture ignore the incorporation of new lands in the USSR, a re-calculation of the indices on the basis of this essential amendment shows that over the whole present decade the rate of increase in Russia's agricultural output will actually be no more than about 10 per cent. The corresponding rate of expansion in industry will be 30 per cent. Over the whole period from 1932 to 1950, Russia's net national income—as was pointed

out in the first article of this series—will have been quadrupled. Her agricultural output over the same period will only have been doubled.

Lagging nature of Soviet farming

The lagging behind of Soviet farming becomes even clearer as one turns from the somewhat dubious general indices to the concrete target figures for grain crops, industrial crops and cattle breeding. The total grain harvest planned for 1950 is 127 million tons. The following table compares this total with the grain crops of the preceding Plans as well as with the figures for the last year before the collectivisation and for the last year before the first World War:

GRAIN CROPS

	Tons		Tons
1913	75,200,000	1937	107,000,000
1928	66,800,000	1940	118,000,000
1932	61,900,000	1950	127,000,000

Before the collectivisation the grain crops were still considerably below their pre-revolutionary level, a clear indication that farming based on technical primitive small-holdings meant stagnation. After the shock of collectivisation the situation became even worse than before. The 'Liberalization' of the statutes of the collective farms that took place in 1935 and the simultaneous mechanization resulted in a steep and steady rise in output in the last years before the war. The target figure for 1950 is only 7 per cent above the 1940 crop, a figure considerably less than the 27 per cent increase planned for 'total farm produce'. But the 7 per cent increase, too, is somewhat fictitious since between 1940 and 1950 Russia has acquired the Baltic lands and the Bessarabian 'granary'. The sowing area under grain crops—about 106 million hectares—remains almost stationary, in spite of the fact that much new land was brought under the plough in the years of the war. The average yield of grain per hectare is planned to reach 12 quintals by 1950, a yield comparable to that of Poland or Italy before the war, which is considerably higher than the yield in the countries of extensive farming like Canada or the United States, but also much lower than the yield in countries of intensive farming like Great Britain or Germany.

Success of collective farming

The success of collective farming has been more striking in industrial crops; and it is also here that the new Plan promises most. The output of raw cotton is to reach 3,100,000 tons in 1950, compared with less than a million before collectivisation, 2,500,000 in 1937 and 2,300,000 tons in 1940. In consequence of the war the cultivation of cotton has greatly diminished. Half a million hectares of irrigated land have been abandoned in the Uzbek Republic, which was the most important centre for cotton growing. The Plan envisages the reclamation of that land as well as the completion of several large-scale irrigation works such as the Kirov System in the Hungry Steppe (also in the Uzbek) and a number of others for which the local peasantry itself is to provide the labour. The yield of raw cotton per hectare is to increase from 16·5 quintals before the war to 18·4 quintals in 1950.

The cotton plantations have suffered from the war only indirectly; their recovery is not therefore expected to take much time. The cultivation of sugar beet, nearly all of which was concentrated in the Ukraine, is expected to recover much more slowly. The output for 1950 is fixed at no more than 26 million tons, compared with 31 million in 1940 and with a target figure for 1942 of 30 million tons. The yield per hectare is expected to be fairly low at 19 tons compared with a 25-tons yield that was planned for 1942. Here again little has been published about the present condition of the sugar beet farms in the Ukraine, but it may well be that their state is such as to make the target figure for 1950 appear very ambitious indeed. The situation with regard to other industrial crops is more or less similar with the exception of flax, in which a very considerable expansion is planned.

Stock breeding industry

The war has, however, inflicted the most heavy losses on the stock breeding industry. Here figures have been published on the basis of which it has been possible to make an accurate computation of Russian livestock in 1945 and to compare the target figures of the new Plan with the present situation.

The table is quoted from the *Sotzyalistichesky Vestnik*, a periodical published by the anti-Soviet faction of the emigre Mensheviks in the

U.S.A. Its accuracy has been checked.

	Horses	Horned cattle (in millions)	Sheep and goats	Pigs
1929	34·6	67·1	147·0	20·4
1938	17·5	63·2	102·5	30·6
1945	10·5	47·0	69·4	10·4
1950	15·3	65·3	121·5	31·2

Towards the end of the first Five-Year Plan Russian farming had not yet recovered from the 'greater slaughter'. The new 'greater slaughter' of the war (for which the Russian peasant, of course, was not responsible) has been equally disastrous. The number of horses which Russian agriculture possesses now is less than one-third of the figure for 1929 and only slightly more than half of the pre-war figure. One-fourth of the horned cattle, more than half the sheep and goats and two-thirds of the pigs have been lost through the war. A quick recovery of the losses is hoped for, but the number of horses in 1950 will still remain considerably below the pre-war figure.

Tractor farming

The replacement of the draught animal by the tractor, on which the functioning of collective farming has always been dependent, has now become an even more urgent need than ever before. The new Plan provides for a total output in the years 1946 to 1950 of 720,000 tractors calculated on a 15 h.p. basis. The actual number of tractors and mechanical agricultural implements that will be supplied to the farms will be about half that figure, since the average horse power of a tractor is to be considerably higher. The new traction power with which Soviet farming will be supplied over the next five years will amount to 10,800,000 h.p. In 1939, in his report to the Eighteenth Congress of the Party, Stalin put the total mechanical horse power employed in Soviet farming at that time at 9,250,000 h.p. The new Plan thus envisages a total replacement of the mechanical horsepower of Soviet agriculture. This target, if reached, will be a tremendous achievement; but the need to set so high a target throws light on the very critical conditions prevailing at present. The mechanical basis of Soviet farming has been shattered by the war.

Fertilizers

Equally significant is the plan for the production of mineral fertilizers—nitrates, phosphates and potash. Soviet farming is to be supplied with 17,000,000 tons of fertilizers over the next five years, which is almost exactly double the amount it received during the second Five-Year Plan. The increase planned has been necessitated by the utter impoverishment of the soil, not only in former invaded territories but also all over Russia in the years of the war.

Future of the five-year plan

This brief survey of Russian agriculture in the light of the new Five-Year Plan leads to the conclusion that the rehabilitation of farming will depend primarily on the capacity of Russian industry to restore the mechanical basis of agriculture in the next five years. Even if this very great task is discharged with success, farming will still be lagging behind industry in its development as it did before the war. But the new Plan, if carried out fully, would create favourable conditions for an unparalleled rise of productivity later on, a rise the beginnings of which were very marked in the last years before the war.

It would be idle to speculate on the new Plan's chances of success. But this much at least is clear; to overcome the present crisis in agriculture, Russia must at all costs reduce to a minimum the sector of its industrial effort that is devoted to armaments. The replacement and renovation of the whole mechanical tractive power of agriculture would hardly be conceivable if, say, large-scale production of tanks were to be planned at the same time. Russian diplomacy in the next few years—if it is to be genuinely realistic—ought to base itself on the peasant's tractor, not the armoured car. But it is also clear that in the next few years, before the economic rehabilitation is really completed and before the impressive target figures of the new Plan become a reality, the strains and stresses in Russian agriculture may become acute and even dangerous enough to induce the Soviet Government to adopt some new policies towards the peasantry and also to revise some of the features of the Plan in the process of its execution.—Reproduced from the *Economist*, July 20, 1946.

CONTOUR CULTIVATION AND STRIP CROPPING

By Sir WILLIAM J. JENKINS

THE Government of Bombay has recently sanctioned the establishment of three centres of 50 acres each in Ahmednagar, Sholapur and Belgaum districts whereon experimental work on contour cultivation and strip cropping will be carried out by the Agricultural Department. These improved methods of agricultural technique offer great possibilities in checking soil erosion and in increasing and maintaining soil fertility in many parts of India. Accordingly, the results obtained from these experimental centres will have an importance and significance extending far beyond the provincial boundaries and must be of interest to all engaged on agricultural improvement and development in this country.

What is contour cultivation?

Contour cultivation is merely the carrying out of ploughing and other tillage operations along the contours of the land. In short, it can best be described as 'farming on the level'. It is not a new practice. 'Horizontal' or contour ploughing is referred to by the agricultural writers of ancient Rome. The main object of this tillage practice is to make every furrow serve as a small dam or obstruction which will hold and retain rain water, so that the rainfall has time to sink into the soil and become available for crop production to the fullest possible extent.

Ploughing up and down the slope of a field, which is the reverse of contour ploughing, results in the formation of a series of channels, i.e. furrows, down which surplus rainfall, which cannot immediately be absorbed by the surface soil, runs with increasing volume and speed. The result is soil erosion, the destruction of the fertile upper layer of the soil, the leaching out of plant food, the birth of gullies and the gradual, but inevitable, transformation of good land into barren and unproductive wastes.

Sir WILLIAM J. JENKINS, KT. C.I.E., I.A.S., is Agricultural Commissioner with the Government of Bombay.

In the United States of America, where contour cultivation is now an essential and recognized component of modern soil conservation practice, tests, conducted over many years, have shown that a contour-tilled field may retain as much as twice the amount of rainfall as will be held in a field of similar soil, size and gradient in which ploughing has been done up and down the slope. In addition, contour farming 'on the level' is easier work for both bullocks and farm tractors and for the men who drive them in carrying out tillage operations. Less power is needed to operate farm implements horizontally and the saving of time is also appreciable.

In a previous article published in the issue of *Commerce* of 14 September, I emphasized the importance of contour cultivation, i.e. contour furrowing, in the improvement of grasslands and grazing areas. Since such contour furrows, both on cultivated and uncultivated lands, store rain water within the area of precipitation, contour tillage has a definite value in flood control, a subject which is arousing much attention in many parts of India at the present time.

Strip cropping

Strip cropping is a logical complement to contour cultivation. Indeed, the combination of the two practices is essential in order to realize the fullest benefits of either. Strip cropping consists of the cultivation of strips or belts of different crops along the contour of sloping fields. It is also no new system of crop management. Originally practised in Europe many centuries ago, strip cropping has spread in numerous countries of the world. In an

elementary form, it is being practised today in some parts of India. In the United States of America, the technique of strip cropping is common agricultural practice in almost all tracts liable to wind or water erosion. It is admitted to be one of the easiest and most effective methods of retaining soil in its place, of conserving soil moisture, especially on inferior types of land, and of increasing crop outturns. In his world-famous book *Soil Conservation*, Dr H. H. Bennett, Chief, Soil Conservation Service, the United States Department of Agriculture, describes this technique of strip cropping as 'the foundation practice that has made continuous cultivation possible and permitted the use of other good farming methods'.

Recognized types of strip cropping

Two main types of strip cropping are recognized. The first of these is contour strip cropping in which the strips of different crops follow the natural contours of the land and are arranged at right angles to its natural slope. The second type is known as field strip cropping in which crops are grown in strips or bands of uniform width across the general slope of the field but not necessarily conforming to the actual land contours. Both of these systems of strip cropping are practised, the former being preferable where there is danger of soil erosion by rain water and on gently undulating lands; the latter is recommended only for irregular, steep, and broken areas where the first method is not practicable.

In general, under an effective system of strip cropping strips or belts of crops which permit soil erosion, e.g. cotton, *jowar*, *bajra* or corn should be sandwiched between strips of erosion-resistant crops such as close-growing leguminous crops, e.g. groundnut, soyabean, horse-gram (*Dolichos biflorus*), black gram etc. or small grain crops of which wheat and barley are common local examples. The denser vegetation of the close-growing leguminous crops act as 'safety belts' by holding the soil and reducing erosion losses. They may also be compared to 'filters' which retain the soil washed down from the erosion-permissive crop strips so that, even on steeply graded fields, the soil, as a whole, remains *in situ* and is not washed away to irrecoverable loss in nullahs and rivers.

Work done in U.S.A.

During my visit last year to the United States of America, I spent some time at the Blackland Conservation Experiment Station, Temple, Texas. In many ways, the soil climatic complex of the tract in which this Station is situated resembles closely that of the 'black cotton soil' areas of the Bombay province and Central India. The annual average rainfall is about 35 in. and is mostly received in short, intense storms during the late spring and early autumn. The predominating soils of the Blackland Prairie area are very dark and of a heavy clay texture. As stated in the Station Handbook, these soils 'are high in colloidal clay and subject to extensive swelling and contraction under the influence of alternate wetting and drying'. On such soils, as with similar soil types in India, the percentage of rainfall lost as surface runoff is high. Consequently the erosion hazard, even on the most moderate slopes, is considerable.

Naturally, I was most interested in the results obtained in soil conservation experimental work in a tract in which the climatic, soil and physical features resemble so much those prevailing over large areas of the 'scarcity' zone in the Bombay province. At this Experimental Station at Temple, Texas, a great deal of research work has been done on the effect of contour cultivation plus strip cropping in checking soil erosion. Over a five-year period, viz. 1933 to 1938, the actual average soil loss resulting from rain water erosion was six tons per acre on the contour-tilled, strip-cropped fields with an average gradient of 5 per cent. On similar fields where cultivation and cropping had been done up and down the slope, the average annual soil lost by erosion amounted to 53 tons per acre. Earlier results from similar experiments, quoted by Dr Bennett, show soil losses on strip-cropped fields as being 2·7 tons per acre and 14·5 tons per acre in 1934 and 1935 whereas on fields under other methods of cultivation, the figures of soil losses per acre in these two years reached the alarming totals of 104·6 tons and 64·5 tons respectively.

The experts at the Station have estimated that, without proper soil conservation measures, including contour tillage and strip cropping and under existing systems of tillage and crop rotations, a field with a 4 per cent slope would lose 6 in. of surafce soil in 36 years

or that, in a lifetime, the farm as a fertile crop-producing area would be destroyed. Such a prospect holds out no hope for continued agriculture and can leave only a heritage of poverty for future generations. Yet, the same destruction of fertile land is in sad progress in many parts of India as is evidenced by the low average of crop yields per acre and the increasing recurrence of crop failures in many localities especially where soil erosion is prevalent and unchecked.

Need for contour cultivation in India

Contour cultivation, combined with strip cropping under suitable crop rotations, is not only an insurance against the loss of the surface soil by erosion but is also a definite and important measure towards increasing and maintaining soil fertility. The same leguminous crops which, by their dense and close-growing character, hold the soil in place are the best crops for soil-building because they add nitrogen as well as organic matter to the land. Accordingly, in India, and especially in the black soil areas, and over inferior dry land tracts, strip-cropping systems must be devised on a rotational system suited to local conditions. Under such rotations, the strips of erosion-permissive crops, e.g. cotton, *bajra*, *jowar* and corn must be rotated with the strips under (a) leguminous erosion-resistant crops, and (b) small grain crops, e.g. wheat, oats, barley, etc. In some areas, permanent buffer strips of pasture grasses may possibly be included in the rotation area. The cycle of the desirable rotations will depend upon the crops, soil, land gradient, climate, rainfall and other factors. It will be recognized how vast a field there is for experimental work in this connection in all parts of the country. What has not yet been sufficiently recognized, however, is the urgency for such research work to be commenced on an all-India scale at once. On the successful results of such investigations, may well depend the security of our soils and the health and welfare of our peoples for many generations to come.

In Bombay province

There are few, if any, parts of India where the problems connected with soil conservation and the increase and maintenance of soil fertility are more important and imminent than in the province of Bombay. Over large tracts of that province, fertile soil is being removed in lakhs of tons annually by rain-water erosion. This loss of the farmers' capital is preventable. The methods of contour cultivation and strip cropping, especially in combination with scientific land-terracing or bunding, are all-important means towards this end. For that reason, the experimental work initiated by the Government of Bombay is of very vital importance to the future welfare of the province. This programme of work was submitted to Dr J. R. Johnstone, the expert soil scientist at the Blackland Conservation Experiment Station, Temple, Texas, for his opinion and advice. In his reply, this experienced soil conservationist writes: 'With due consideration to the factors of food supply, soil fertility, erosion control and adapted crops, you have a system which should find wide application wherever agricultural conditions exist similar to those of the Bombay province.

In conclusion, I suggest that what is needed in many parts of India is to abandon 'square farming in a round country'. The reformation and rehabilitation of our agriculture must be preceded by a revision and adaptation of our fields and crop rotations by which the development of scientific strip-pattern cropping on the land contours will be given due prominence and attention. Each furrow must be made to serve as a check on rain-water runoff and as a barrier to soil loss by erosion. With the soil secure and stable and with the right crop in the right place, a whole new pattern of profitable agriculture will emerge, a pattern of prosperity.

—Reproduced from *Commerce*, Sept. 28, 1946.

Book Reviews

CALL OF THE LAND

By J. N. Chakravarty (General Printers and Publishers Ltd., Calcutta, 1946, pp. 150, Rs. 3.)

Mr J. N. Chakravarty, who retired as Director of Agriculture, Assam, has written a book to 'indicate some of the causes of the present stagnation in India's agricultural conditions'. The author has planned to acquaint the young men of the country with their 'prospects in agriculture' and has tried to draw their attention to the problem of improving the distressing agricultural position of the country.

The author has begun by reiterating that 'agriculture is the back-bone of India', but the country occupies the lowest position in the world either as measured by *per capita* income or agricultural produce per acre. The situation is worsened by the rising trend of population. The result is a persistent shortage of food. The causes of food production and rural development have suffered, according to the author, for want of coordination, absence of leadership and neglect of the human factor.

The Indian rural problem cannot be isolated from other problems facing the country and a general improvement depends on simultaneous progress in all spheres of life. With the cessation of hostilities the problem of unemployment is looming large before the country. In the opinion of the author 'the occupation which provides employment for the bulk of India's population' is likely to absorb the 'largest proportion of discharged personnel'.

Farming has to be learnt. The author holds that selected villages should be developed as centres for agricultural training. All reasonable amenities of life should be provided in order to attract suitable persons. There should be 'a closer link between agriculture and universities'.

The author has drawn attention to the existence of a long chain of middlemen between the State and the actual cultivator and to the evils of fragmentation. Both these have adversely affected the agricultural economy of the country and effective measures should therefore be adopted to eliminate them.

The crops to be raised and the particular farming practice to be adopted will depend on the nature of the land. In order to profit by farming, scientific methods of agriculture should be adopted and special attention should be paid to improved tools and machinery, fertilizers, improved seeds and irrigation. 'Agriculture does not lend itself to spectacular results', but it has been pointed out that in the case of paddy for instance, a substantial contribution to India's wealth may be effected if the present production is raised by 30 per cent.

India has the largest bovine population in the world, but her milk position is far from satisfactory. In this country bullock power is the mainstay of agriculture, but even with regard to this essential animal, only a pair is available, we are told, for every ten acres. There is also an insufficiency of cattle feed. These facts illustrate 'the colossal nature of India's animal husbandry problem'.

It has been pointed out that the spare time of farmers should be profitably utilized and a number of subsidiary occupations has been suggested for adoption.

Agricultural finance and cooperative movement have been dealt with at length as also agricultural marketing. The author aptly says that India does not lack in natural resources and these should be fully utilized for agricultural development. He pleads for the elimination of the middleman and for the establishment of cooperative organizations for marketing.

In the chapter on 'Collective Farming' a comparison has been made with conditions in India and those obtaining in Tsarist Russia. The state of collective farming in Soviet Russia and the success it has achieved there has been described at length. 'If the Soviet has been able to effect a revolutionary transformation in a quarter of a century', why can we not in India?

A large amount of useful information has been collected in the book and the manner of presentation is attractive. The book suffers from the drawback of having a large number of printing mistakes. It is on the whole a timely publication.—U.N.C.

News and Views

MAKING THE GOOD EARTH STAY

ONE of the most important subjects discussed at the Empire Scientific Conference held in London recently was the serious problem of soil erosion, which faces the administration of some Commonwealth countries.

In some parts of Asia, especially India, erosion amounted to the transformation of thousands of square miles of formerly arable and pasture-land into semi-desert. The question is closely bound up with the problem of nutrition and of the relation of population growth to food supply. Soil erosion—the wearing away of soil, caused by failure to take the precaution needed to preserve its fertility and stability in the face of wind, rain and other climatic factors—has been responsible for the creation of a serious situation in agriculture in many countries. In Africa the problem has been of very recent growth and has been largely the result of the introduction of the European mode of agriculture for catch crop production, without due recognition of local peculiarities of the soil and traditional methods of tillage and pasture. Furthermore, both in Africa and India, overgrazing by cattle and goats has been a large factor in erosion. In Africa many communities have looked upon the number of cattle as a measure of wealth, quite apart from the value of the herds for food production.

The Conference discussed the three stages of overcoming soil erosion. The first stage is by mechanical obstacles to the movement of the soil, such as terracing the cultivation on the contour. The second stage is by the proper utilization of land to ensure the retention of its fertility, and with this is bound up the question of afforestation. The third stage is the development of social and economic conditions in which acquired agricultural methods can be applied. Knowledge of the first two stages is now fairly complete, but the third stage requires extensive research.

The state of nutrition in several parts of the Commonwealth was also discussed, together with methods of improving the situation. The Conference emphasized that from the remedial point of view there were few cases of malnutrition that could not be cured with synthetic productions, already available in large quantities in industrial countries. The use of such methods turned largely upon methods of transport and clinical administration.

Among methods mentioned, the application of known principles in food technology seemed to offer fruitful short-run possibilities. The increased use of manufactured yeast as a protective foodstuff; the introduction of iodine into salt; improved milling of rice; the inclusion of iron and calcium into cereal foods; the drying of fruit and vegetables; all these were technical methods capable of widespread application in a comparatively short time. The problem of nutrition did not, however, rest with such short-term remedies. The problem was concerned with the whole agricultural structure of the Commonwealth, where indigenous populations were increasing beyond capacity of existing methods of food production.

Although both Africa and India contained vast herds of cattle, the number available for slaughter annually was small. That situation could not be improved without the breeding of strains better able to resist tick-borne and other diseases, and the more effective handling of the pests problem. In India, improved animal husbandry depended largely on controlled breeding.

One method of improving local breeds of livestock in tropical countries was to import breeding stock for crossing purposes. If this practice was to be successful, further study was needed of how breeds of livestock could adapt themselves to widely varying climatic conditions, such as high temperature and high humidity.

Various chemical elements, such as cobalt and copper, were required by both plants and animals in minute quantities. In many parts of the Commonwealth both crops and livestock suffered from a deficiency of one or other of these elements; further research was required as to the cause and the treatment of these deficiencies and the functions of these elements in plant and animal life.

Crop pests and diseases and the methods of their control were also discussed. More basic knowledge was required about the resistance of plants to various forms of parasitic attack, and increased research was needed into the possibility of breeding varieties resistant to diseases. Plant breeding to improve crop production was in need of a greater variety of plant species on which to work, and for this purpose it was strongly felt that plant-collecting expeditions should be organized and that the plants so collected should be grown and studied at specially selected centres.

Special emphasis was laid on the importance of soil survey to serve as a guide to the proper utilization and development of land. Before such surveys could be made it was necessary to agree on a common system for the classification of soils, and what features, such as chemical and mineralogical, should be considered in such a classification. In this work the soil surveyor must keep in close touch with the ecologist, recording the vegetation and animal life of an area, so as to link up the soil with plants and crops that grow in it and the animals that feed on them.

It was felt that further work was needed to discover basic facts concerning the supply of nutrients as well as the influence of organic matter on soil fertility and anti-erosion properties of the soil. Reference was also made to the increase in food production that was possible in some parts of the Commonwealth by increased knowledge of the water-holding and water-supplying capacity of soil. This would be particularly important in connection with both irrigation and land drainage.—Steward Ketley (U.K.P.S.)

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INDIAN FARMING

APRIL 1947

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ADVISORY BOARD MEETS[1]

GENTLEMEN,

ALLOW me to extend to you a hearty welcome on behalf of the Council and on my own behalf. It is a matter of very great pleasure to me to welcome you here today, as I have been one of yourselves for very many years and I consider it a great privilege that I have been called upon to serve you in the capacity of Vice-Chairman of this Council.

I know many of you have come from far-off places after long and tiresome journeys and I am painfully aware of the fact that we have not been able to arrange for you as comfortable accommodation or a more central place for the meetings as I would have liked to do, but I can assure you that our best efforts failed in this respect on account of acute shortage of accommodation in Delhi, particularly at a time when both Houses of Legislature are in session.

Since we last met, the cruel hand of death has taken away from our midst the Hon'ble Sardar Sir Jogendra Singh who was, in more ways than one, our true friend, philosopher and guide for many years. Perhaps many of you are not aware that it was he who, as a member of the Council of State, moved the resolution which led to the appointment of the Royal Commission on Agriculture, one of the main recommendations of which was responsible for the creation of this very Council. Sir Jogendra Singh was known to most of you. I need hardly say to an audience like this how dear to him was the cause of advancement of agriculture and welfare of peasantry in India, and how assiduously he worked for it as a non-official, as the Minister of Agriculture in the Punjab for a number of years, and later on as Member-in-charge of Education, Health and Lands Department of the Government of India. I am sure all of you would like to join with me in paying him a last tribute of our gratitude, love and affection, and in conveying to the bereaved family our deepest sympathy and respectful condolence in their irreparable loss.

I would now proceed to the pleasant duty of conveying to our friend and fellow member, Sir Roger Thomas our heartiest congratulations on the well-deserved distinction of Knighthood conferred on him in the last Honours List. This honour is a matter of particular gratification to us, as you all know that, he is not only a very active member of this Council and of similar other bodies, but he has thoroughly identified himself with the agriculturists of India, and has himself made great contribution to the agricultural development of India during his many years' stay in this country. I would also like to convey to Messrs. Walker and McIntyre my heartiest congratulations for the honours conferred on them since we last met.

We have a heavy agenda in front of us and I do not, therefore, wish to make a long speech as we must get down to our work quickly. There is only one item in the agenda to which I would like to invite your special attention. This item relates to the improvement of villages in Delhi province (item No. 27-A). I am not divulging any secret, nor do I wish to influence your judgment in any way when I say that I am responsible for this scheme being put up on behalf of the Imperial Council of Agricultural Research. Ever since I became a member of the Council in 1931, I have felt that there was a good deal of force in the criticism that the schemes financed by the Imperial Council of

[1] Opening speech by Sardar Bahadur Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research at the Advisory Board on 10 March 1947.

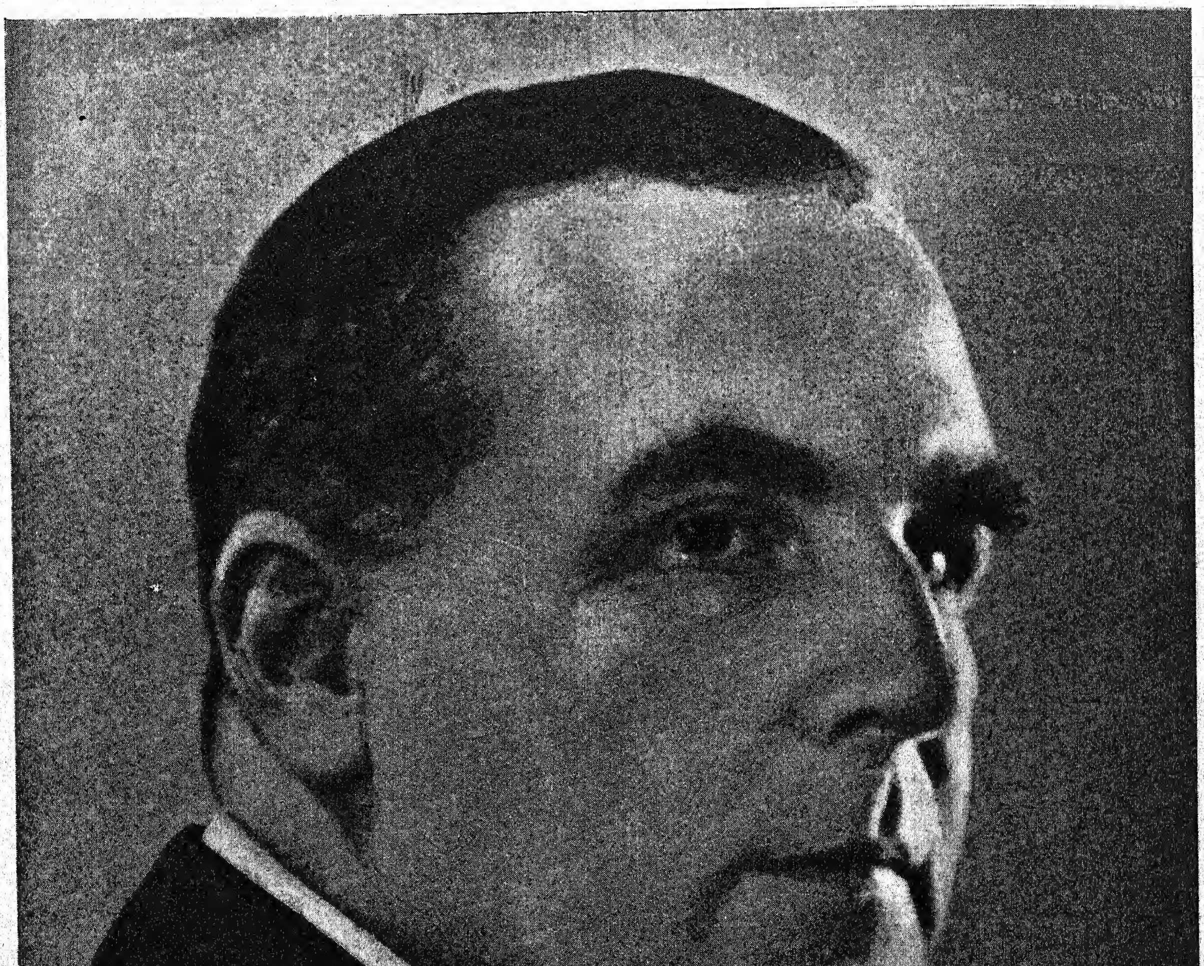
Agricultural Research are divorced from actual conditions in the villages and that, even when some results of practical and economic value are obtained as a result of such schemes, there is no sufficient follow-through from the laboratory or the experimental farm to the fields of the cultivators, and that before we can confidently recommend any result for adoption by the cultivators, we should first try them out under village conditions in which the cultivators work and live. Secondly, we have not seriously tried out the various improvements recommended by our experts in a compact area to ascertain their feasibility and their net result in raising the standard of living of the villagers. I am aware of the fact that some work of this nature was attempted in various schemes under village project schemes, but I am afraid, they have not been quite successful. I, therefore, thought that we should try out these ideas in an area not far from Delhi and after discussion with the local administration and the experts at headquarters, I had the scheme drawn up. This has been examined by the Agronomy and Developmental Research Committee and now the recommendation of that committee will be put for your consideration. One obvious criticism will be the high cost of the scheme, but I would like to point out that although provisions for various subsidies have been made, it is not proposed to distribute them until and unless the need for each of them has been established beyond doubt. The staff appointed under the scheme will, in the first instance, persuade the villagers to adopt the improvements recommended by experts and it is hoped that many of them would be adopted without payment of subsidies. The payment of subsidies, as I have said before, will be made only in the last resort when methods of persuasion and example have failed. The cost of the scheme is in the last analysis the cost of the staff, the scale of which, I think, does not exceed what is proposed in the post-war development plans of many provinces and States and I entertain the hope that they will be able to persuade the cultivators by example and precept to adopt the improvements recommended by them without payment of subsidies. For my part, I shall not consider the scheme as success until and unless I find that these improvements have caught the imagination of the villagers not only of the villages included in the scheme but all the neighbouring villages far and near, and the latter show eagerness and anxiety to adopt them of their own accord. I trust you will kindly consider this scheme in the light of these remarks and, in any event, agree to a trial being given to it for a period of five years. You are no doubt aware that recently the constitution of the Imperial Council of Agricultural Research has been changed so as to enable it to finance such pilot schemes of development which will serve as a model to the rest of India.

One other comment I wish to make is that it has been felt that in respect of some schemes, no results have been achieved, although they have been going for a good many years. The inference is inescapable that either these schemes are ill-conceived and not basically sound, or their design and layout require radical changes. It cannot also be denied that there is often a good deal of duplication of work. I have given this matter careful consideration and I think the solution lies in having a group of allied schemes reviewed by an expert from time to time as was done in the case of horticultural schemes by the Fruit Development Adviser. I expect to have this done as soon as the new Agricultural Commissioner and the additional staff, already sanctioned on agriculture and animal husbandry sides, have been appointed.

Before I sit down, I sincerely hope that you will extend to me the same measure of goodwill and cooperation which you have done in the past while we have been working together on different committees, so that we may worthily serve the cause of agricultural research in this country.

Sardar Bahadur Sir Datar Singh, Kt., F.R.S.A.

PLATE 37



Sir Herbert R. Stewart, C.I.E., M.Sc., F.R.C.Sc.I., D.I.C., N.D.A., I.A.S.

moisture to utmost advantage. Thus preparation of seed bed, time and system of planting, placement of manures, post-planting operations, etc. have all to cater to this end. Further because of the light nature of the soil and the general deficiency of humus, need for incorporating adequate quantities of organic matter into the soil is urgent and the practice of green manuring an indispensable one in the cultivation schedule. Besides, the improved schedules has to provide for adequate drainage during the monsoon period and for sufficient support to the rootstock to guard against lodging which often occurs due to strong winds accompanying heavy showers. Finally the off-take of the crop has to be so arranged as to enable the grower to recover most of his crop, to minimize the danger of pest and disease carryover and to facilitate recuperative processes of the soil. As a small farmer is not able to replenish the soil with adequate manures, this last aspect is of no small consideration. The system of cultivation described in the following pages is based on these considerations and the actual operations have been detailed at length and illustrated.

Implements

The country plough is still to a large extent the all purpose implement with the cultivator. Though the deeper and the finer tilth required for sugarcane is understood, considerations of capital outlay stand in the way of cultivator procuring better implements. The implements recommended by the Sugar Bureau in 1925 consisted of a mould-board plough for ploughing, a double-mould plough for riding, a horse hoe and a gatherer and roller. All these were of the expensive type and suited only the planters and zamindars. There was thus an urgent need for a set of cheap and efficient implements which could be kept in proper adjustment by the cultivator himself. The Bihar plough, the Bihar ridger and the Bihar cultivator made by a local firm, were the result of careful and continuous work on the part of the local Department of Agriculture for nearly five years. They are comparatively simple implements and only the portions working the soil are made of metal. The chain hitch adjustments for widening and deepening the furrow, were dispensed with and the number of nuts and bolts were reduced to the minimum. The implements are available in two sets, senior and junior, fit for strong and ordinary pair of bullocks and are normally priced at Rs. 38 and Rs. 25 (for the set of three) respectively. Besides the different weights of the implements in the two sets, the junior set has only a three-tined cultivator whereas the senior has a five-tined cultivator. Besides these three main implements, a beam *henga* to break the clods and press the land down during cultivation and after planting, a *desi Kanta* to break the crust and a furrow *henga* to ensure firm contact of the sett with the soil in the furrow are required.

Preparatory cultivation

Green manuring with *Sannai* (*Crotolaria juncea* L.) in light, well-drained soils and with *dhaincha* (*Sesbania aculeata*) in heavy lands subject to waterlogging, is recommended for cane and wherever this can be done, it is very necessary that the crop is buried by the end of July or at the latest the first week of August, to enable proper reduction of the fibrous material. If, as is at present the case, the land cannot be spared for green manuring, in spite of its established economy, but must be used for a cereal crop during the monsoon, it should be sown with early maize, early paddy or *marua* or some similar crop which can be harvested early in September. In either case it is necessary to start the preparatory cultivation towards the end of September or early in October when the monsoon is practically over. Heavy lands subject to inundation or waterlogging during the monsoon are, however, generally ready for ploughing only towards the end of October or beginning of November. The recommended schedule of preparatory cultivation is as follows:

(1) One ploughing with Bihar plough towards the end of September to break the land, and bury the weeds; beaming to break clods, followed after a few days by cultivation with Bihar cultivator to increase the tilth and beaming again.

(2) The land is not touched till the sowing of winter cereals is over (i.e. middle of November). If, however, there is rainfall during this period, a cultivation and a beaming are generally beneficial to destroy weeds that still persist and also to open up the soil.

(3) After the pressure of *rabi* sowings is over, farmyard manure or compost is applied in lands which have been either fallow or cropped with maize, etc. during *kharif*. For this purpose 100 md. per acre is recommended. The application is followed by ploughing with the Bihar plough. Along with this ploughing, sub-soiling to secure better and deeper tilth is also done. For sub-soiling, the Bihar ridger with the mould-board removed is suitable and this implement is worked in the furrow made by the plough. The operation of sub-soiling should be done along with the last ploughing so that the plough pan is not formed again till the planting of cane. Light and medium lands not much infested with weeds come into good tilth with the second ploughing and the sub-soiling in these cases may be attempted along with this second ploughing. But heavy loams require an additional ploughing, when the sub-soiling should be deferred till the third ploughing, i.e. in December. After ploughing, the land is beamed well to preserve moisture.

(4) After these ploughings, the land is not touched till it is ploughed for planting at the end of January unless subsequent rainfall forms a crust on the surface or induces weed growth. In either case, a cultivation with the Bihar cultivator and a beaming are essential.

Planting

This should be done between the end of the third week in January and the end of February, varieties being generally planted in the order of their ripening. The operations at planting are:

(1) Selection of seed material from healthy crop free from diseases and pests or crop specially grown for the purpose. The lower internodes which are generally rooted at nodes and contain hardened or damaged eye-buds should be rejected. Similarly where top borer damage is serious, the top nodes should not be used for planting. The canes are cut into three budded setts. Borer-infested canes and canes showing reddening at cut ends are rejected. Soaking the setts in water or in lime wash (saturated solution) for 24 to 48 hours helps to increase germination and ultimate yield and can be profitably done wherever facilities are available. This treatment is essential when moisture conditions are not up to the mark due either to poor monsoon in the previous year or poor preparatory tillage. Setts made from freshly cut canes are the best but where either the canes or setts must lie over for sometime, they should either be soaked or at least kept under a covering of moist paddy straw or trash.

(2) Straight furrows 3 ft. apart for thick and tall varieties and $2\frac{1}{2}$ ft. apart for thin and short varieties are opened with the senior or junior ridger and manures are applied in the furrows. The Sub-soiler is worked in the furrow to mix the manure and also to provide loose soil below the sett.

(3) Three budded setts are planted in the furrow, eye to eye, in the case of setts with long internodes and end to end in the case of setts with short internodes. Under average conditions, the rate of planting is generally one sett per foot thereby requiring 14,520 setts per acre. The setts are pressed with the feet as they are arranged in a line in the furrow.

(4) The central tine of the cultivator is removed and the cultivator is passed along the furrow. The side tines disturb the soil on the sides of the furrow throwing it in the furrow, and covering the setts. After this operation is done, the central tine is fitted and the cultivator passed along the ridge between the furrows to level the ridges and also throw more soil into the furrow. The entire area is then beamed twice to make the land level and also press the soil against the sett. This operation is extremely important in an environment of losing moisture where unless contact between the soil and the sett is complete, germination usually fails to take place. To ensure such a contact in a better way, planting schedule has been slightly modified: furrows are opened, manured, and setts placed in the furrows in the evening but they are covered over only early next morning instead of the usual method of opening the furrows throughout the day. This modification affords increase in moisture content in the furrow, permits of better contact and results in quicker and fuller germination.

Hot-weather cultivation

As occasional showers are common in March, April and May, it is necessary to break the crust so that germination is not impeded. The country *Kanta* or any improved peg harrow is suitable for the purpose. The hot-weather cultivation which is a very important operation

SIR HERBERT R. STEWART

AN APPRECIATION

SIR Herbert Stewart, C.I.E., M.Sc., F.R.C.Sc.I., D.I.C., N.D.A., I.A.S., joined the Agricultural Department in 1920 and was posted as my second Assistant—the first being Mr. O. T. Faulkner, C.M.G., the Associate Professor of Agriculture. I well remember Mr. Faulkner's remark sometime after Stewart had joined us, 'our new man is a bit inhuman but a keen worker' and my reply, 'he will be alright as his wife will correct that aspect—the important thing is keenness on his work'. This judgment proved very correct for when I left the Department in 1921 Mr. Stewart, as he then was, became Associate Professor and later on Mr. Faulkner's departure in the autumn of the same year he became Professor of Agriculture. He became Assistant Director of Agriculture in 1928 and was promoted Director of Agriculture, Punjab in 1932 and held that post for nine years up to 1943 except for a short period in 1938 when he was attached to the Imperial Council of Agricultural Research. He became Agricultural Commissioner with the Government of India in May 1943 and in May 1944 Vice-Chairman of Imperial Council of Agricultural Research. He left India in November 1946 to take up the important post of Agricultural Adviser to the Middle East under the Foreign Office. He was awarded the C.I.E. in 1939 and a Knighthood in 1946. This meteoric progress can be rivalled by few, if any, Member of the Agricultural Service.

His knowledge of agriculture was wide and extensive, but his chief characteristic was his administrative ability, particularly exemplified in his conduct of large and varied Committees such as Indian Central Cotton Committee, the Jute Committee, etc. He always knew his subject thoroughly as President of a Committee and could produce documents to support his case, without any fumbling or muddle.

As Director of Agriculture in the Punjab he made it his duty to know his all large staff personally, and learnt to judge and appraise their value very accurately. In this way he secured the enthusiastic support of all his good men and raised the efficiency of the Department accordingly.

The study and recording of farm accounts is perhaps his most important contribution to research. These studies are now an important feature of the publication of the Board of Economic Inquiry, Punjab.

His nine years as Director of Agriculture, Punjab were marked by all round progress in almost every line of agricultural development. Some of the more important successes were as follows :

(a) Introduction of wheats 591 and 518 now sown in at least three million acres out of the ten million in the province.

(b) 289F/K25, though selected at Khanewal could not have spread to an area of 250,000 acres, without his broad-minded support. This variety is now being reselected at Khanewal under the auspices of the Indian Central Cotton Committee and is temporarily being replaced by the Department's 124F and 199F—two excellent varieties.

(c) New varieties of gram and many other crops were evolved during his regime.

(d) Fruit culture in the province made remarkable strides and the area under citrus mainly increased more than five times.

(e) Over fifty thousand chaff cutters are in use in the Punjab and considerable progress has been made with the Bar Harrow, Drills, etc.

(f) The Agricultural College at Lyallpur now trains over 500 students at a time.

(g) Research work at Lyallpur and elsewhere made great strides. Cotton research, oilseeds, cereals, fruit represent some of the main lines where excellent progress has been made.

His friends in India will wish him and Lady Stewart health and happiness and many good memories for the future.—(William Roberts.)

Original Articles

SUGARCANE IN BIHAR

II. CULTURAL ASPECTS (NORTH BIHAR)

By K. L. KHANNA

THE area under sugarcane in Bihar is roughly 4,50,000 acres of which nearly 2,75,000 acres are grown in North Bihar and 1,25,000 acres in South Bihar with the remaining area scattered over eastern and south-eastern portions and Chota Nagpur. Sugarcane growing in North Bihar is unique in as much as the crop is grown entirely without irrigation. The Indo-Gangetic alluvium of this tract is highly calcareous with soils varying from very light sandy loams to fairly heavy clay-loams but the bulk of the area comprises medium loams. The calcium content, however, exhibits considerable variations ranging from 1 to 30 per cent. The tract is interspersed by a large number of rivers which keep the water table fairly high and also enable lateral seepage to take place to such an extent that fairly satisfactory yields of almost all crops can be obtained without irrigation. The climate is equable being neither very hot in summer nor very cold in winter. The average maximum temperature usually does not exceed 100°F. in April which is the hottest month of the year. On individual days in summer the temperature may, however, go up to 108°F. Similarly the average minimum temperature in winter does not fall below 48 to 50°F. except in January when after a good shower it may be sometimes as low as 40°F. Frosts are rare. The tract is humid all the year round except for two months, viz. March and April when due to westerly winds, atmospheric humidity often falls below 20 per cent during the day. During the rest of the year it is well above 50 per cent on the whole. The yearly rainfall varies from 45 to 60 in., its incidence increasing towards the eastern portions. The south-west monsoon usually breaks about the middle of June, when approximately 7 in. of rain is received in about 10 to 12 days. The full force of the monsoon is felt in July and August which together contribute nearly 50 per cent of the yearly total, each having 15 to 20 rainy days and much cloudiness. The last phase of the rainy season gives about 8 to 9 in. in September. The north-east monsoon is very weak and does not usually yield more than an inch of rain during January and February. Floods are a recurring phenomenon causing waterlogging and submergence over a considerable part of the area. High winds are not infrequent during September when they often result in lodging of the crop. The four districts namely, Champaran, Saran, Muzaffarpur and Darbhanga that comprise the white sugar tract north of the river Ganges have roughly 5 per cent of the cultivated areas under cane and support 26 white sugar factories. The entire area is thickly populated and intensity of cropping is consequently very high.

K. L. KHANNA is Sugarcane Specialist, Bihar.

Principles underlying improved methods of cane cultivation

In view of the fact that the area is entirely dependent upon rain and that the latter is received almost six months before the due date for planting of the crop, it is essential that all possible moisture received during the previous monsoon is conserved to ensure satisfactory germinations and early stand. The latter is important because no amount of subsequent treatment and manuring can make up for the loss of poor germination and filling of gaps on a large scale is scarcely feasible in an environment of decreasing moisture. This naturally calls for timely and frequent cultivation between the cessation of monsoon and early spring and every other precaution to utilize the conserved

generally starts when the germination has progressed to an extent that the rows can be clearly made out. The Bihar cultivator is passed between rows of cane lightly stirring the soil and uprooting the weeds. Four to five intercultivations are generally essential during the period April to June. Intercultivation is absolutely essential after every shower of rain in the pre-monsoon period.

Earthing up

This operation is done with the Bihar ridger which throws the earth up into a ridge along the rows of cane and leaves a furrow down the middle of the inter row space. The operation is usually done at the full break of monsoon. The proper timing of earthing depends upon the nature of soil, the variety and the time of planting. In light soils earthing up can be slightly delayed but in heavy soils it is necessary that this is done before the soil becomes too wet to impede proper working of the ridger. Quick growing varieties have to be earthed up early to minimize damage to the stalks during earthing. Tillering, however, is the most important factor in relation to earthing. The optimum number of tillers should be properly initiated before earthing is taken up. A crop planted at the right time (i.e. during the first half of February) is generally ready for earthing up at the commencement of the monsoon but in a crop planted late (i.e. in March) tillering will be a little delayed and earthing operation has to be adjusted accordingly. As tillering is also a varietal character, the optimum time will be different for different varieties. Among the approved varieties at present, Co313, Co395 and Co453 tiller well and quickly. Co508 produces the least number of tillers and is late while Co513 is profuse in tillering but is comparatively later than the others. A light early (mid-May) earthing has been found to be beneficial in both stimulating tiller growths and reducing stem borer (*Argyria sticticraspis* Hamps.) incidence in both light and heavy types of soil. Considering that over 70 per cent of the millable harvest consists of pre-monsoon tillers, the significance of early light earthing is obvious.

Before earthing, it is necessary to intercultivate once, especially if the surface soil has become caked up in order that the ridger throws fine mellow soil on either sides instead of clods or slices. Second earthing which is sometimes done a month after the first earthing, is helpful in facilitating proper drainage and also in smothering the weeds that have resisted the first earthing or have come up later.

Operations after earthing

Attending to drainage during the monsoon is equally as important as conserving moisture during the previous cold and hot weather. For this purpose, it is necessary that the ends of the furrows after earthing are opened with *kodali* and connected with a small channel running at right angles to the furrows so that surplus water can get out of them. The small channels should be allowed to drain into a main channel leading preferably to nearby paddy fields so that no nutrient matter being carried by this water is lost to the cultivator. Water stagnation in the field should be reduced as much as possible. Other operations are limited to the supporting of clumps that lodge due to excessive rains accompanied by high winds. As the crops are not heavy, elaborate arrangements for supporting canes are not often required. Tying four clumps together (two adjacent clumps in one row and the two clumps facing them in the next row) with their own dry leaves is generally found to be sufficient to meet the requirements in this respect.

Harvest

Harvesting is generally done according to factory requirements and the time of ripening of varieties. The canes are cut flush with the ground and stripped of leaves in the usual manner. Recent work[1] has, however, shown that harvesting by uprooting the clump with *kodali* termed as stubble harvesting, is advantageous though it may entail some extra labour and time. About 8 to 11 per cent extra tonnage depending upon the variety and soil type is recovered. The juice quality is similar or slightly superior to the usual method and after accounting for additional cost of harvest,

[1] Further coordinated trials with new method of harvest conducted at the instance of the station in Bihar, United Provinces and the Punjab, have shown the method to be definitely superior, economical and useful and fit for general adoption by the cultivators in Northern India.

cleaning the lower portions of canes, etc. a sufficient margin of profit (average Rs. 13 per acre) is left. Besides, there is the advantage of getting the field rid of stubble which may otherwise help the carryover of the insect pests and diseases from one season to the next and the land also gets the benefit of being broken up to some extent immediately after the harvest. This breaking up helps the subsequent ploughing which is an arduous operation as the land gets hard and improves nitrification which is at its height during the hot weather months.

IRRIGATION PROGRAMME

'THE U.P. Government's irrigation programme, which is expected to be completed by 1951, will increase the irrigated area in the province by about 1·3 million acres', said Mr. Hafiz Mohammad Ibrahim, Minister for Communications, at a press conference on March 4. He added that the total irrigated area from all sources would be increased to 36·5 per cent from 33 per cent when the Nayar Dam Project, which was partly an irrigation and partly a hydro-electric power scheme, was completed. The Nayar Dam Scheme was expected to irrigate 420,000 acres and increase the food production by 70,000 tons.—*Press Note.*

CONTROLLING PLANT DISEASES[1]

By B. B. MUNDKUR

MOST of our food crops annually suffer tragic losses due to disease. The precise value of such losses is, however, unknown as accurate plant disease surveys have not been carried out in India. There is little doubt that they run into millions of rupees as the diseases cause great fluctuations in yields and contribute in no small measure to shortages in food supplies. It is to the advantage therefore of the grower and the consumer alike that every acre of land that is ploughed and seeded produces the maximum amount of yield and if that can be achieved by the adoption of simple measures, then such measures must be unhesitatingly adopted.

A large number of plants diseases are due to fungi, bacteria or viruses. Fungi which cause more damage than the rest are, however, both our friends and our foes. In their friendly role they provide us the delicious morels and mushrooms. Yeasts which are fungi, are essential in the manufacture of bread, wines, beer and other alcoholic drinks. Penicillin and streptomycin, the new drugs which are proving so useful in alleviating human suffering, are metabolites of fungal activity.

But by causing blights, mildews, smuts, rusts and other diseases too numerous to mention, fungi do much harm to our field, orchard and other crops. In order to save human lives from hunger, no effort should be left undone to eliminate these diseases.

The task of a plant pathologist

Reducing losses from diseases is primarily the task of the plant pathologists who are attached to the central and the more important provincial and State Departments of Agriculture in India. A plant pathologist, let it be understood, is not a physician or a surgeon. He is a sanitary officer whose major aim is to keep away disease.

[1] Talk delivered over the All-India Radio, Delhi, on 22 May 1946. Published with the permission of the Station Director.

B. B. MUNDKUR, M.A., Ph.D. (Iowa State) is Second Mycologist in Indian Agricultural Research Institute, New Delhi.

He keeps a vigilant watch and when a disease appears, he identifies the fungus that is responsible for it, studies the factors of environment that cause epidemics, finds out how it is transmitted and disseminated, how it over-winters or over-summers and then discovers methods for its control.

Controlling an externally seed-borne disease

There are two ways in which plant disease can be controlled. Firstly there are the direct methods whereby the plant pathologist, knowing how a disease is transmitted, devises measures that should be taken to prevent its appearance. A disease may be seed-borne. If it is an externally seed-borne disease, then the plant pathologist wages a chemical warfare against it by using fungicidal dusts such as those of copper or mercury compounds, sulphur or formaldehyde. The most essential thing in carrying out such a warfare is to see that these dusts are of extreme fineness and that they completely cover the seed surface. The grain smuts of *jowar*, the covered smut of barley, the foot-rot of rice and the damping off of vegetable and tobacco seedlings are controlled in this manner.

Controlling an internally seed-borne disease

If a disease is internally seed-borne, then the plant pathologist tries to kill the fungus lying within the seed by the application of heat. Loose smut of wheat, for example, is an internally seed-borne disease and over-summers in India in the form of dormant mycelium within the seed. In 1888 Jensen of Denmark reported that if the seed is soaked in water at 80°F. for four hours, then the dormant mycelium within the seed starts to germinate. If the seed is then placed in water registering 128 to 129°F. for ten minutes, the fungus is killed and a complete control of the disease is obtained. Luthra and Sattar of Lyallpur have devised an ingenious modification of this method which is useful in regions with very hot summers like the Punjab and Sind. The grain is soaked in

water from early morning till noon, the water is then drained off and the seed is exposed to the sun in a thin even layer from noon to sundown; by that time, the germinating mycelium is effectively killed and the grain itself perfectly dried.

It is always a good practice to treat all seed with fungicidal seed dressings, whether a disease-causing organism is or is not present. Not only are good stands of crops obtained in this manner, but that is a best form of crop insurance also.

Controlling an air-borne disease

If the diseases are air-borne like the early and late blights of potatoes, mildews of mango, grape or peas, leaf-curl of peaches, scab of apples or rust of figs, then the plant pathologist has different weapons in his armoury to fight and prevent epidemics. By systematic field observations on the time of appearance of these diseases and by noting the effect of meteorological conditions, he builds up an efficient forecasting service so that timely spraying of foliage, blossoms, buds and fruits can be done in order to give the plants a protective coverage. Later when the spores of the pathogen settle down on the leaves covered by this protectant layer and start to germinate in the presence of moisture, that moisture activates the fungicides also which then completely kills the spores. Spray calendars and spray schedules thus form an essential requisite to the vegetable and fruit growers. In the coffee-growing districts of Mysore and Coorg, thousands of gallons of Bordeaux spray are used daily for controlling the dreaded coffee leaf rust. The protection which the spray gives to the foliage effectively controls that rust and increases the yields of coffee.

Because of the war many of the old fungicides like the copper and mercury compounds are in short supply. In the United States of America alone, it is stated that twenty million pounds of copper, for the manufacture of fungicides, were used in 1943. The trend in that country has therefore been to develop non-metallic synthetic organic compounds that are more effective and less injurious, more convenient and less expensive, than the older fungicides. With the aid of the organic and industrial chemists, new combinations have been manufactured or old ones improved. Among the newer fungicides, Dithane, Fermate, Spergon, Arasan, etc. have shown much promise. In India it should be possible to manufacture these products under licence from the patentees; or may be our organic and industrial chemists can, with the active cooperation of the plant pathologists, synthesize newer and better products.

Indirect methods of disease control

But very often in crops like wheat or rice and diseases like rusts, mildews or leaf-spots that affect them, sprays are of little use because the area that is to be covered is too vast and the time to conduct the spraying operations too short. As the margin of profit is low, the cereal producer cannot afford to invest money in expensive fungicides. In cooperation with the plant breeders therefore the plant pathologist endeavours to develop varieties of crops that are immune from or resistant to diseases. Such methods of disease control are the indirect methods.

In conducting investigations of this nature, the primary requirement is to determine the factor or factors that induce disease in an epidemic form under experimental conditions. If such conditions are known, then a susceptible variety would, for instance, completely succumb to the disease under those conditions. By subjecting as many varieties as possible to an epidemic of a disease, it is possible to select varieties that have the required properties. Varieties of the particular crop are secured not only from all over the country but from abroad also. When such varieties are subjected to the disease and if among them are some that fail to take infection, at a time when susceptible ones get most severely attacked, and if such performance is repeated year after year, then there can be little doubt that they are immune.

Very often varieties may show different degrees of susceptibility. Even among the most susceptible varieties, there may be a few plants that fail repeatedly to get attacked. If such plants are not disease-escapes, then they perhaps have within them genes that are responsible for immunity or resistance. By careful selection and repeated testing to make sure that they are not disease-escapes, it should be possible to build up resistance in them.

Varieties of cereal crops immune from or highly resistant to several smuts have been

obtained in this manner at the Indian Agricultural Research Institute at New Delhi. An intensive and extensive search is going on to find out varieties of wheat, barley, linseed and other crops that are immune to rusts, at the same Institute. Effort is also being continuously made at the Potato Sub-station of the Institute at Simla to find out varieties that can resist fungi that cause the early and the late blights of potatoes. Not only have varieties been collected for this purpose from all over India but they have been secured from Mexico and the countries lying on the slopes of the Andes mountains in South America where the potato originated.

But the development of immune or resistant varieties of crop plants is not an easy process. Just as there are different varieties of crops, there are different varieties of a fungus also. These varieties, known as parasitic races of the fungus, cannot be distinguished one from the other by any observable characters. But they differ in their ability to attack the different varieties of its host. In black rust of wheat, for example, there are about 175 parasitic races. Some of them attack some varieties of wheat alone and others attack other wheat varieties. In India nine such races are known and we have wheat varieties that are more or less resistant to their attack. But suddenly a new race may arise which is capable of attacking our resistant wheats in a severe manner, thus upsetting all our calculations.

The development of immune or resistant varieties is also a time consuming process. Sometimes an immune or resistant line may not be agronomically good or commercially satisfactory. Wilt-resistant pigeon peas, for example, are very undesirable because of poor yielding capacity and also because of poor cooking qualities. In such cases, the breeders have recourse to hybridization between the immune or resistant varieties on the one hand and desirable but susceptible ones on the other.

It has been observed that the introduction of new selections or of new hybrids to control one disease has introduced new disease problems or changed old ones. For instance, a wheat hybrid highly resistant to black rust was found to be very susceptible to a disease known as black chaff. When the rust-resistant variety was introduced in North Dakota and Minnesota, black chaff began to cause much concern.

The plant pathologist has to mobilize therefore all the methods of control or commonsense procedures that prevent dissemination of diseases or reduce the severity of their attacks. In addition, therefore, to disinfecting seed, obtaining seed from disease-free areas, spraying his crop and securing resistant varieties, he should explore suitable rotations, select proper soil types for different crops, take adequate care of the soil to maintain its fertility and make the right use of manures and fertilizers. Amelioration may lie in the choice of any one or all these measures.

PREVENTION OF ADULTERATION OF *GHEE* WITH *VANASPATI*

By NOSHIR N. DASTUR

THE lay consumer sometimes gives too great an importance to the physical appearance of *ghee* when judging the quality. For this reason products which resemble *ghee* in appearance are likely to be passed off as genuine *ghee* by unscrupulous dealers. With the growth of the hydrogenation industry such substitutes are easy to obtain and when mixed with *ghee* it is not always easy to detect even by routine chemical tests if the adulteration is carried out to the extent of 25 to 30 per cent. This is no doubt due to the great variation in the composition of *ghee* and to the common practice of allowing the sale of mixed *ghee* (cow and buffalo). In these circumstances it is no wonder that the lay consumer is left in bewilderment and experience has made him so sceptical that when he buys *ghee* he takes it for granted that *ghee* is always adulterated.

This state of affair is not at all to be encouraged for it indirectly does a great harm to the genuine *ghee* industry by lowering the price of *ghee*. The *vanaspati* industry, no matter how honest the motive of the manufacturer is, also comes into disrepute. A remedy has, therefore, to be found which will benefit both these sister industries without restricting their legitimate sphere of activity. At present three remedies are available to rectify this state of affairs. These are (i) adding sesame oil to *vanaspati*, (ii) adding phenolphthelein to *vanaspati* and (iii) colouring *vanaspati* with a characteristic colour. The merits and demerits of each of this proposal are discussed below.

Addition of sesame oil to vanaspati

The proposal to add sesame oil to *vanaspati* rests upon the characteristic colour, red, giving property of sesame oil when it is mixed with sugar (or furfurol) and strong hydrochloric acid. The test is not given by any other natural fat. This method of detecting sesame oil has been known for nearly half a century and has been put to use in other countries for preventing the use of butter substitutes (margarine) for adulterating butter. It is compulsory to add a certain percentage of sesame oil to all butter substitutes. This greatly simplifies the work of the analyst for one is never sure whether the variation in the customary chemical and physical constants of butterfat are genuine differences due to feed or due to adulteration. Addition of sesame oil to the extent of about 10 per cent has been legally enforced in Austria, Belgium, Denmark, Finland, Germany, Portugal, Sweden, Switzerland and other countries.

The colour-giving property of different batches and varieties of sesame oil varies and further it is possible to impair this property by the common processes of refining as practised during the manufacture of *vanaspati*. To overcome this difficulty the law is framed in such a way that the butter substitute when tested under standard conditions by the furfurol test is required to develop a certain minimum intensity of red colour. This ensures an addition of 5 to 10 per cent of sesame oil.

Some times it is argued that an addition of 5 to 10 per cent of sesame oil will lower the keeping quality of *vanaspati* under our climatic conditions. Actual experiments carried out under these conditions show that the keeping quality is not affected to any considerable extent. With *vanaspati* containing 5 per cent sesame oil it is possible to detect adulteration to the extent of 2 per cent and more. Sesame oil when added to the extent of 5 to 10 per cent does not impart any foreign colour or taste to *vanaspati*. The only objection to this method is that presence of sesame oil cannot be visually detected and a chemical test has to be employed which though very simple cannot be entrusted to a layman as it involves the use of strong hydrochloric acid.

Addition of phenolphthelein to vanaspati

The addition of phenolphthelein is advocated on the ground that as it is white and completely

NOSHIR N. DASTUR, is on the staff of the Indian Dairy Research Institute, Bangalore.

odourless and tasteless it will be easily adopted by the *vanaspati* industry. Phenolphthelein gives a red colour with alkalies and its presence can be easily detected. There are, however, several important reasons why its addition cannot be recommended. On account of its white colour its presence will not be easily evident to the buyer. Phenolphthelein is only sparingly soluble in *vanaspati* and it will easily settle at the bottom and hence can be removed by scrapping the bottom when *vanaspati* has solidified. The biggest objection to the use of of phenolphthelein is, the idiosyncracy of individual to this chemical. While phenolphthelein is regularly used for its mild cathartic effect, in certain individuals it produces very violent reaction in the form of reddish skin and erruptions.

Colouring of vanaspati

To prevent the use of *vanaspati* for adulterating *ghee* it has been suggested that *vanaspati* should be coloured distinctively so that its colour will not blend with that of *ghee*. This will be the best solution of this most vexed question as it will provide a visual test. Addition of either sesame oil or phenolphthelein do not fulfil this essential condition. The colour suggested should no doubt be attractive and perfectly harmless. It is suggested that light rose or pink colour will be the best. This is no doubt an odd colour. However if it does not in any way affect the cooking property of *vanaspati* the public should be educated to get accustomed to this colour.

In this connection dye obtained from *Ratanjot* roots has many advantages. This is indigenous, is readily available and commonly used for preparing food preparations. The dye is absolutely non-toxic and can impart any shade of red. However, for the purpose under review a light pink shade will suffice. It should be remembered that *vanaspati* is used solely as a cooking medium and not as a spread-like butter. Hence colouring will not affect the market value of *vanaspati* in any way. *Vanaspati* coloured with *Ratanjot* also does not impart any colour or flavour to food prepared in it.

It is sometimes argued that colouring is not a fool-proof method as the colour can be removed by chemical reagents. No method can be called fool-proof in this age of science. An antidote can always be found. The above argument is no doubt made by interested parties with the object of frightening the authorities against giving a distinctive colour to *vanaspati*. The same sources like to gloss over the fact that even the colour-giving property of sesame oil can be impaired to an equal extent by treatment with various absorbents like activated charcoal, Fuller's earth, etc. Removing colour from large quantities of *vanaspati* is not an easy matter and if ever it is practised on a large scale it cannot go undetected for long from the vigilance of law. When *vanaspati* is coloured pink its presence in buffalo *ghee* can be detected to the extent of 5 per cent and in cow *ghee* to the extent of 15 per cent. The *Ratanjot* dye has the further property of giving an intense blue colour with alkalies and this can serve as an additional test.

Advantages and disadvantages

The advantages and disadvantages of the three proposals outlined above are tabulated below:

	I. Addition of sesame oil	II. Addition of phenolphthelein	III. Colouring *vanaspati* with *ratanjot*
1.	No effect on the colour of *vanaspati*	No effect on the colour of *vanaspati*	Colours *vanaspati*
2.	5 to 10 per cent of oil does not affect the keeping quality	(Not ascertained but presumably no ill effect)	Keeping quality unimpaired
3.	Adulteration visually not evident	Adulteration visually not evident	Adulteration visually evident
4.	Very soluble in *vanaspati*	Solubility limited	Very soluble in *vanaspati*
5.	Not removable by filteration	Removable by filteration if more than 0·005 per cent	Not removable by filteration
6.	Non-toxic	Cathartic reaction varies with individual	Non-toxic
7.	No cumulative effect	Cumulative effect varying with individual idiosyncracy	No cumulative effect
8.	Does not impart colour to food	May impart colour to food if any alkali is present	Does not impart colour to food
9.	Heating to high temperature impairs detection	Heating has no effect	Heating to high temperature reduces colour
10.	Colour-giving principals removed by absorbents	Removable by filteration or by absorbents in concentration greater than 0·005 per cent	Colour removable by absorbents

It is recommended that all the *vanaspati* and similar products manufactured in the country or imported should be made to contain both sesame oil and a distinctive colour as a double check against its misuse for adulteration of *ghee*. The amount of sesame oil to be added should be fixed at 5 to 10 per cent and the colour intensity should be 7 to 9 red units when measured in one cm. cell in a Lovibond Tintometer. If these measures are adopted the consumer will be amply protected against any fraud.

U.S.A. DESTROYING POTATOES

ACCORDING to a Reuter message the U.S.A. is having to destroy more than 1,000,000 tons of potatoes to keep prices up while many countries, including Britain, are going short. Britain declined an offer of two and a quarter million tons of surplus American potatoes for fear of importing ring rot to the danger of the home crop, and because the cost of handling, carriage and, if necessary, dehydrating would raise the price far higher than the same amount of flour even if the potatoes were a gift. The order to destroy the first half million tons came on the very day the FAO said : 'The destruction of basic foodstuffs in order to maintain prices is an international crime'. The same fate is expected to await the next two crops since the high fixed price encourages production.

Commenting on this Gunther Stein says : 'While hunger and malnutrition are still rampant in India and other countries, American farmers, acting on Government advice and getting Government compensation will dump at least 20,000,000 bushels of low-grade surplus potatoes. Sufficient food to provide a full basic diet for three-quarters of a million people for an entire year will thus be ploughed under, discarded, destroyed. The surplus is considered a dangerous drag on the American potato market, already artificially supported by Government subsidies, amounting to Rs. 250,000,000 in 1946. UNRRA cannot send those potatoes abroad. Shipped in ordinary vessels, they would spoil. Even if enough refrigerated ships were available, the freight rates would be too high. And modern technology which was used during the war to dehydrate potatoes for American soldiers overseas is of no help either. It is too expensive'.—*Food Bulletin.*

A NEW AND LUCRATIVE ROTATION FOR SUGARCANE

By S. B. SINGH

ROTATION of crops is generally practised to improve the fertility of the soil, keep the labour properly engaged throughout the year, and to obtain the maximum yield and profits from the land.

In sugarcane cultivation generally good cultivators either keep the field fallow or green manure it with *sanai* (*Crotolaria Juncea*) preceding a crop of sugarcane. The other and the poorer type of cultivator generally takes a paddy or a cotton crop during monsoon and follows it with pea in the *rabi* season before sowing sugarcane. Although this type of cultivator gets both a *kharif* and a *rabi* crop, he loses very heavily in the yields of cane. Cultivators with small holdings who are forced to plant sugarcane immediately after harvesting a *rabi* crop abound in the eastern districts of the United Provinces where generally population is thick. As a consequence of this practice, the average yield of sugarcane is only about 12 to 14 tons per acre.

A new rotation

With a view to improving the fertility of the soil and the average yield of sugarcane on small holdings, a new rotation (groundnut-*arhar*-sugarcane) has been tried both on the research and certain private farms in the United Provinces. It enables the cultivator to take a *kharif* and a *rabi* crop immediately preceding sugarcane without any loss in the yield of cane. This new rotation has yielded very encouraging results in well-drained light loam soils. The rotation briefly consists of taking a groundnut crop in the *kharif* and an *arhar* crop (*Cajanus*) in the following cold weather followed immediately by sugarcane.

Arhar and groundnut are sown together with the break of monsoon, the former in lines 9 ft. apart and the latter in between the lines of *arhar* at a distance of 1½ ft. between each line. There are thus 5 lines of groundnut between the two lines of *arhar*.

Arhar is thinned during August so as to leave good and healthy plants at a distance of 2½ to 3 ft. It is intercultivated with hand hoes or *kassis* during July and August along with groundnuts. After harvesting the groundnuts in November, the spaces occupied by the groundnuts are prepared for planting cane in the same manner as a normal field reserved for cultivation of sugarcane in trenches. Trench method of planting cane has been found better suited to this rotation than flat planting. Lines of *arhar* fall on the ridges of trenches and remain undisturbed during cold weather. Trenches are made 3 ft. apart and hoeings and manuring are done from November onwards. Sugarcane is planted in these trenches in the month of February and by the time germination of sugarcane begins the *arhar* crop is harvested, in March. *Arhar* plants being fairly apart (2½ to 3 ft. from plant to plant and 9 ft. from row to row) become very bushy and yield 50 to 100 per cent better than an ordinary crop of *arhar* (*Cajanus*). Certain *arhar* plants have been found to yield even up to 2 lb. of *arhar* seed per plant. The sugarcane crop raised from such a field is also usually a bumper crop yielding from 700 to 1,000 md. (25 to 36 tons) of cane per acre depending upon the variety of cane and its proper care. Early varieties generally yield less than the medium ripening varieties. The crop of sugarcane raised in these trenches is often much better than the crop of sugarcane normally raised after a fallow or even green manure.

The yields of different rotational crops obtained from trials conducted at Sohna Agricultural Farm, Basti and Main Sugarcane Research Station, Shahjahanpur are given in Table I.

S. B. SINGH, M.SC., PH.D., (CANTAB.) was lately Director, Sugarcane Research Station, Shahjahanpur.

TABLE I

Yields and prices of different rotational crops

Year	Place of trial	Rotational crop	Yield in md.	Prices in rupees
1939-41	Sohna Agricultural Farm, Basti	Groundnuts	16·0	144
		Arhar	19·0	190
		Sugarcane, Co. 421	1050·0	919
1944-46	Main Sugarcane Research Station, Shahjahanpur	Groundnut	14·6	131
		Arhar	15·9	159
		Sugarcane		
		Co. 245	727·0	636
		Co. 557	883·8	773

Advantage

The advantage of the above rotation is that the crops preceding sugarcane being leguminous have a fertilizing effect on the soil. Of these, *arhar* is a deep-rooted crop and groundnut a shallow-rooted one. The cultivator gets two cash and food crops without irrigation and manuring and also a good sugarcane crop within two years. This practice is better than keeping the land fallow or even green manuring it and is specially suited to small cultivators who cannot afford to keep their land vacant for nearly a whole year before planting sugarcane.

The above rotation is best for all well-drained medium or light loam soils where *arhar* and groundnut crops can be successfully raised.

INDIA'S SUGAR QUOTA FOR 1947

THE International Emergency Food Council announces that India has been allocated 1,260,000 short tons of sugar, Japan 50,000 and Korea 40,000 short tons (one short ton equals 2,000 pounds) for 1947. Most of India's allocation is expected to be filled from domestic production with only 120,000 tons to come from the world surplus.—*Food Bulletin.*

SOME EXPERIMENTS ON THE CONTROL OF TOMATO VIRUS DISEASES

By R. S. VASUDEVA and T. B. LAL

TOMATO virus diseases are very serious and cause heavy damage to tomato crop every year. It is one of the most extensively cultivated vegetable crops in India. Since the high vitamin content of tomato has been established it has become all the more popular and is considered essential from nutritional point of view. The diseases are prevalent wherever the crop is grown and some of them seriously reduce the yield as well as the market value of the fruit. Observations made in Delhi, the Punjab, United Provinces and Bihar show that a very high percentage of plants are infected with virus diseases. In certain individual fields almost every plant is affected and the loss to the individual cultivator is considerable. All the varieties grown are found affected with one or more diseases.

Disease-incidence

Observations on the incidence of virus diseases of tomato were made at Delhi for three seasons, i.e. 1941 to 1943. Records of disease-incidence were made at frequent intervals in plots where tomato seedlings of variety *Sutton's Early Market* were transplanted about the middle of August. In 1941-42 the total incidence of mosaic, streak, leaf-roll, mosaic-cum-leaf roll and leaf-roll-cum-streak was 24·5, 9·2, 8·6, 3·3 and 0·6 per cent respectively. The highest incidence of mosaic, leaf-roll and streak was observed on 16 October 1941 after which date the spread of the diseases was comparatively much slower. In 1942-43 the total disease-incidence was 6·5 per cent on 16 September 1942, after which date the incidence began to rise gradually. On 11 December 1942 a maximum incidence of 28·2 per cent was recorded. Plants showing streak were more common than mosaic, and typical leaf-roll was almost absent. In 1943-44 the total disease-incidence as recorded on 10 September 1943, was 4·2 per cent and gradual rise in disease-incidence was observed up to 20 December 1943 when a maximum of 78·7 per cent was registered. Incidence of mosaic (including severe and negligible mottle) was the highest, being 70·3 per cent.

The total disease-incidence was much lower in 1942 as compared to 1941 and 1943. The insect incidence during the period of observation in 1942 was also lower. These variations in disease and insect incidence may be explained on the basis of meteorological observations. During August and September 1942, total average weekly rainfall was 0·799 in. and average weekly humidity remained much below 75 per cent which resulted in high insect activity with a corresponding rise in disease-incidence. In 1942 during the same period total average weekly rainfall was 2·911 in. and average weekly humidity ranged between 78 and 93 per cent. These conditions resulted in much lower insect activity with corresponding fall in disease-incidence. During 1943 for the same period the total average weekly rainfall was 1·07 in. and average humidity ranged between 78 and 87 per cent. The conditions though being intermediate to those observed in 1941 and 1942 were nevertheless favourable to high insect activity and consequently resulted in high disease-incidence.

Effect of virus diseases on yield

Preliminary observations on the yield records of healthy plants as well as those affected by different diseases indicated that in the case of plants showing symptoms of mosaic, streak, leaf-roll, mosiac-cum-leaf-roll and leaf-roll-cum-streak, the average yield per plant in terms of number of fruits was reduced by 9·6, 36·8, 76·2, 68·7 and 95·7 per cent respectively and average yield per plant in terms of weight by 10·8, 54·0, 84·2, 73·2 and 98·9 per cent

R. S. VASUDEVA is Seed Potato Production Officer and T. B. LAL is Senior Assistant in the Division of Mycology and Plant Pathology, Indian Agricultural Research Institute, New Delhi.

respectively in comparison to healthy plants.

It was also observed that in cases of late infections with mosaic the yield was not appreciably affected.

In a typical experiment records of yield of individual plants, both healthy and affected by different diseases, were taken. Yield per plant in each case as well as the percentage reduction in yield in case of diseased plants are given in Table I.

TABLE I

Effect of different diseases on yield[1]

Plant symptoms	Average yield per plant		Percentage reduction in yield
	lb.	oz.	
Healthy ..	12	13	Nil
Mosaic (Negligible mottle)	11	15	7
Mosaic (Severe mottle)	11	0	14·1
Leaf-roll ..	0	14	93·1
Streak ..	0	4	98·0
Mosaic (Severe mottle-cum-leaf-roll) ..	1	7	88·8

Considering the economic importance of these diseases, experiments were conducted in order to devise control measures particularly through plant hygiene, i.e. through protection of young seedlings from infection by spraying, by pruning the plants in such a way as to increase their tolerance, by roguing diseased plants and replacing these by healthy ones and by shifting the date of sowing of nursery and subsequent transplanting of the seedlings into the field. As the chief means of spread of these diseases are insect vectors, the methods adopted to control the diseases will include those that control insects or avoid the period of optimum insect activity. The experiments conducted with these objects in view are described below.

Plants of tomato variety *Sutton's Early Market* raised from seed obtained from disease-free plants were throughout used in these experiments and the treated plots were randomized. The plots were evenly manured with farmyard manure at the rate of 100 maunds per acre and the sowings were normally carried out at the optimum time for the appearance of diseases.

[1] The yield shown against leaf-roll or streak is from plants which got infected while young and showed typical disease symptoms. These do not include cases of late infection.

(a) *Varietal test:* A large number of varieties of tomato, seed of which had been obtained from different sources in India, were tested for their susceptibility to virus diseases. In 1941-42, 20 varieties of tomato were transplanted in the field on 4 October 1941. Each variety was replicated four times. Average total disease incidence was highest (81·6 per cent) in variety *Large Red* and lowest (8·1 per cent) in *Type* 1 from Sabour. *Large Red* was affected most serverely by leaf-roll (63·4 per cent). The remaining varieties showed disease-incidence varying from 13·1 to 56·9 per cent.

In 1942-43, 66 varieties were tested. Most of the varieties were affected with streak. High disease-incidence of 61·2 per cent and 53·8 per cent was observed in the varieties *Ox-Heart* and *Pepper* respectively. Minimum disease-incidence of 5·7 per cent was observed in *Sabour Type* 3 whereas variety *Large Red Smooth* appeared to be almost free from disease. Other varieties showed a total disease-incidence varying from 6·6 to 53·6 per cent. The outturn from varieties *Sutton's Early Market* and *Pear Shape* was highest.

In 1943-44, 41 varieties including those which showed low disease-incidence during the previous season, were planted and kept under observation. Varieties *Earliana* and *Golden Yellow* which showed disease-incidence of 9 and 10 per cent during the previous season, showed incidence of 19 and 11 per cent respectively. All the other varieties tested showed disease-incidence of 37 to 100 per cent. Thirty-six varieties showed infection above 70 per cent. In 1945-46, 25 varieties were tested and varieties *Earliana* and *Golden Yellow* were affected to the extent of 93 and 95 per cent respectively. The other varieties showed disease-incidence of 100 per cent.

Observations on different varieties for the last four years have shown that no variety so far cultivated in India is resistant to these diseases.

(b) *Effect of spraying:* Tomato plants transplanted into 24 sub-plots were subjected to six different treatments, each being replicated four times. Unsprayed plots served as checks. The spray used contained nicotine sulphate and soap. No difference in disease-incidence in the sprayed and central plots was observed. Insect incidence, however, was comparatively low in the regularly sprayed plots. The insects commonly observed were *Myzus persicae* Sulz., *Bemisia tabaci* Gen., *Haplothrips* sp., *Haplothrips*

Soror Schmutz., *Engytatus tenni* Rent., *Triphleps tantilus* Motsch., and *Empoasca* sp.

(c) *Effect of pruning:* Tomato seedlings of variety *Sutton's Early Market* were transplanted in eight sub-plots on 6 September 1941. Plants in four sub-plots were pruned every fifteen days while those in the remaining plots were left unpruned and served as checks. After pruning each plant all the instruments were carefully sterilized and hands thoroughly disinfected. Disease-incidence was recorded at regular intervals. The treated plots showed an average disease-incidence of 21·1 per cent as against 21·8 per cent in the controls. There was no appreciable difference in the incidence of mosaic, streak and leaf-roll in the pruned and control plots. Average yield per plant from treated and control plots was as follows:

		Average number of fruits	Average weight of fruits	
			lb.	oz.
Pruned	..	21	2	9
Control	..	25	2	12

(d) *Effect of mixed cropping:* Tomato seedlings were transplanted in 12 sub-plots on 14 September 1942. In four plots, gram and in another four plots maize was broadcast in between the rows of tomato. The remaining four plots served as controls. In the plots in which tomatoes were sown mixed with maize, tomato plants failed to progress satisfactorily and no records were taken in these plots. The average disease-incidence in tomato-cum-gram plots was 9·4 per cent as against 16·0 per cent in pure tomato plots.

Comparatively low infection was also observed in tomato-cum-gram plots in 1943, but the yield in mixed plots was adversely affected.

(e) *Effect of roguing:* Tomato seedlings of variety *Sutton's Early Market* were transplanted in two sub-plots on 9 September 1942. The two plots were isolated by means of a hedge. In one plot all the plants which showed any sign of infection were immediately removed and replaced by healthy ones. Diseased plants in the other plot were not removed and this served as check. The total yield records of the two plots showed an increase in average number of fruits and average weight of fruits per plant in the rogued plot by 92·6 per cent and 68·0 per cent respectively. The differences appeared to be extremely high and the experiment was repeated during 1943-44 on a larger scale. During this year almost all the plants at one time or the other showed symptoms of disease and had to be rogued out and replaced by healthy ones. The yield in these plots was consequently adversely affected and was much lower than that obtained from the control plots. The replacement of plants in the treated plots almost amounted to late plantings. In 1942-43 disease-incidence in general was quite low as compared with that of 1943-44. It is indicated, therefore, that the roguing of diseased plants and replacement by healthy ones may give remunerative returns only during seasons when incidence of diseases is not so high as in 1943-44.

(f) *Effect of sowing date:* Tomato seedlings of variety *Sutton's Early Market* about three weeks old were transplanted in field on six different dates between the second week of August and third week of November during 1942-43 and 1943-44. The disease-incidence was recorded at regular intervals and it was observed during both the years that incidence of severe types of diseases was highest during first two sowings and that there was a gradual fall in the disease-incidence in later sowings. The incidence of *Negligible mottle*, however, was low in the first sowings and gradually increased in the later sowings. It has been indicated that *Negligible mottle* does not greatly affect the yield.

Average disease-incidence in different sowings in a typical experiment is given in Table II.

TABLE II

Effect of sowing date on disease-incidence and yield

Date of transplanting (1943)	Percentage of disease-incidence (Severe types)	Average yield per plot	
		lb.	oz.
11 August	40·7	188	2
9 September	46·8	147	12
27 September	37·5	59	1
16 October	27·9	82	2
1 November	6·0	46	2
18 November	7·2	19	6

In spite of the fact that there was reduction in the incidence of diseases as the time of planting was delayed, there was corresponding decline in yield. The plants of the late-sown crop were smaller in size and occupied a smaller area in the field. It was, however, considered possible to make up the yield in the late sowings by close planting. With this end in view the experiment was repeated during 1944-45 and close planting was carried out in the later sowings, thus effecting an increase in the total number of plants in these sowings. The

distance between plant to plant in plot was so regulated that in the three later sowings the total number of plants was increased by 33, 50 and 100 per cent respectively. Observations for disease-incidence were made in the usual manner and yield of the various sowings was recorded separately. The data are summarized in Table III.

TABLE III

Effect of sowing date and close planting on disease-incidence and yield

Date of transplanting (1944)	Total number of plants transplanted	Percentage of disease-incidence	Average yield per plot lb.	oz.
26 July	72	100·0	67	12
15 August	72	100·0	48	7
6 September	72	90·0	64	9
26 September	96 (33 per cent increase)	62·0	78	10
17 October	108 (50 do)	35·9	124	14
1 November	144 (100 do)	19·5	56	8

From the data presented above it is observed that disease-incidence in the later sowings is comparatively much lower. It is also indicated that by adopting the system of close planting in the plantings of 26 September and 17 October the yield per unit area is considerably increased. In the sowing of 1 November, however, there is a decline in yield, although disease-incidence is minimum. This may be due to the fact that it is too late for planting and the plants do not get sufficient time to make up the yield.

Acknowledgment

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MASS PRODUCTION OF VEGETABLES BY SPRAY IRRIGATION

PRODUCING tomatoes asparagus and vegetables for canning, a single farm of 1,000 acres will soon be under spray irrigation on the river flats of the Murrumbidgee in Australia.

The property was acquired last June, by a packing company, near Gundagai, New South Wales. By next season the company hopes to have 800 acres of asparagus and 200 acres planted with beans, peas, tomatoes celery and white onions. More than half the farm is already fitted with overhead sprays, and before long a series of pipe lines 130 feet in length will water the farm at a rate equal to four inches of rain in 21 hours. Two electric pumps draw water from the Murrumbidgee River at the rate of 67,000 gallons an hour, and the sprays will be kept going almost continuously during the hottest summer months.—*Agricultural Newsletter*.

PINEAPPLE CULTURE IN ASSAM

By S. CHOWDHURY

PINEAPPLE [*Ananas comosus* (L.) Merr. (*A. sativus* Lindl.)] is grown extensively throughout Assam and its cultivation is extending every year to new land. It is grown usually on small hills and hillocks but extensive plantations are also come across on flat land. The plant produces a fruit unsurpassed in excellence by any other. A great advantage of growing this is that unlike most other fruit plants it begins to bear fruit within a short period of planting. There is pretty good demand for the fruit in the towns of the province as well as in Calcutta which gets its supply mainly from Assam.

The pineapple plant

The pineapple is a native of Brazil. It was introduced by the Portuguese into Bengal in 1594 and from there to other parts of India. The fruit is so called because the Spaniard called the fruit *Pina de Indias* from its resemblance to a pine-cone and the English added the 'apple'.

The pineapple is a Monocotyledon and belongs to the Natural Order Bromeliaceae. The plant consists of a short stout stem with roots directly attached and surrounded by a whorl of long narrow stiff leaves standing from 2 to 4 ft. high. The leaves are specialized to make the most effective use of a sparse rainfall, and at the same time, by shading the soil, to keep it cool and moist and hinder evaporation. Even a heavy dew will provide an appreciable quantity of water to the roots. The fruit is a collective fruit formed by the coalescence of a number of individual fruits. Each 'eye' or 'pip' is the extremity of an individual flower which develops into fruit.

Soils and site

Pineapple does best in a loose, open soil, well-drained but moisture-retaining, and with a high humus content. In practice this description exactly fits those soils growing the best plants. A good crumbly sandy loam overlaying a moisture-retaining but well-drained sub-soil is probably the ideal. Very heavy, compact and badly drained soils are not suitable. A slight acid reaction of the soil is desirable.

S. CHOWDHURY, B.SC., is on the staff of the Plant Pathological Laboratory, Sylhet, Assam.

Land either flat or with a gentle slope is best in the tropics where torrential rain will cause severe erosion on cultivated land with a pronounced slope. In choosing a site one naturally ignores any situation subject to flood and conversely any site which will become unduly dry during protracted dry weather.

Propagation

The pineapple may be propagated from almost any part of the plant ratoons, suckers, slips, crowns and pieces of old stems, all serving the purpose. Suckers, however, constitute the best planting material. These are produced in the axils of the leaves and can be used to advantage for establishing a plantation quickly. Suckers are best when of medium size. Very large suckers which are near to flowering are unsatisfactory since they will flower and fruit before being properly established. The fruit will be too small to be of any value, and furthermore, they seldom make strong plants. The best size of suckers are those which will flower about six to seven months after planting. A quicker rooting will result if a few of the base leaves are stripped off.

Next to suckers come slips and crowns. They are equally satisfactory as the suckers, the chief difference being in the time taken to reach maturity. Crowns generally require nearly two years to mature a fruit, while slips take about 20 to 22 months, and suckers about 15 to 18 months. Crown slips because of their small size do not appear of value for propagating purposes.

Ratoons or ground suckers are the shoots that develop below the surface of the soil and are left on the plant for later crops. These ratoons go through a process of leaf unfoldment and inflorescence similar to the parent axis. After the fruit is picked the stalk

withers and the strength of the parent plant is thrown into the ratoons, which therefore develop more rapidly than a new planting. Ratoons are therefore not as a rule used for new plantings.

The stems or stumps of the mother plant may be planted in a shallow furrow and covered lightly with soil. Shoots will spring up but they are irregular and slow in development. So this method of propagation is not usually followed.

Some pineapple varieties produce small brown seeds similar to apple seeds. Such seeds may be used for propagation But it has usually been observed that seeds produced by self-pollinization are usually sterile but crosses with other varieties are quite fertile. Thus it will appear that there is the possibility of the plants raised from seeds not coming true to type. Further seedlings are slow in growth taking a year or longer to reach the size of a crown. Thus it will be evident that propagation by seeds should be attempted only by the plant breeder who is engaged in evolving new varieties by hybridization and not aimed at by the growers.

Varieties

Three varieties are usually cultivated; they are *Giant Kew* or *Smooth Cayenne*, *Queen* and *Joldhup*.

Giant Kew is the most popular variety. It is an exceedingly fine variety and is the best of the fancy pineapples. It occupies the largest acreage and the area under this fruit is always on the increase. It is prized for its large size and keeping qualities; the latter quality enables its transport in good condition to fairly distant markets. The fruit has a firm flesh, is very juicy, rich in flavour and sweet. On an average the fruit weighs about 6 lb., though fruits weighing 10 to 15 lb. are not uncommon in newly cultivated or properly fertilized lands and sometimes fruits weighing as much as 22 lb. have also been reaped.

Queen ranks next in importance. The fruit is remarkably juicy and sweet and the flesh very slightly fibrous. The fruit is smaller than *Giant Kew* and weighs 3 to 5 lb. It is one of the best varieties at present known for general cultivation. It grows freely and fruits early.

Joldhup, a local variety, is grown only in a particular area, the Beanibazar-Latu-Joldhup tract of Sylhet. This area appears to be the oldest pineapple-growing region of the province. *Joldhup* is the only variety grown in this tract and comprises a very large acreage. The fruit is small, sweet, very fibruos with exceedingly large eyes and weighs, on an average, 2 to 3 lb. It suffers serious losses in transit and cannot be sent in good condition to distant markets. The area under this fruit is rapidly decreasing and the *Giant Kew* occupying its place.

Preparation of the land

Although the pineapple is a shallow-rooted plant, the land should be carefully prepared. Old land in all probability lacks humus and efforts to rectify this will pay. Cover crops during the rains will be a nice thing. When it is intended to replant an old block, the old plants will provide a valuable source of humus if they can be cut up and allowed to rot.

In breaking up a virgin land for making a new plantation any trees and brush on the land will have to be stubbed and all the large roots removed. Then to break the surface of the land, it should be given a shallow ploughing or light hoeing of 5 to 6 in. After a thorough discing and harrowing, allow the land to lie fallow for two or three months in order to rot the grass and weeds. If a good rain falls two to three months after the first ploughing a second deep ploughing or hoeing of at least 9 in. should be given, followed by another discing and harrowing. The ground is then allowed to lie fallow for a further period of one or two months and then planted.

System of planting

For the planting of pineapple suckers a spacing of four feet between the rows and three feet between consecutive plants in the rows is recommended. It should not ordinarily be less than 3 ft. × 3 ft. except that in the bed system of planting a minimum planting distance of 2 ft.×2 ft. may be given. In the bed system of planting two, three or four rows of plants are put down in each bed leaving a space five feet wide between the consecutive beds. The bed system facilitates cultural operations as well as the picking of fruits.

In the hills the rows should be along contour lines and the land should be either terraced or cut up into strips by means of contour trenches at least two feet deep and one foot-

wide. Terracing will check the erosion of the soil. The trenches also will serve the same purpose by catching the run-off of rain water. The distance between consecutive trenches should be determined with reference to the gradient of the land; the greater it is, the less should be the distance, 12 to 15 ft. being sufficient on an average slope.

Time of planting

From the purely horticultural aspect, the time of planting is largely governed by suitable weather, both at the time of planting and for the few months immediately following. There is danger of the young plants being washed out or buried in silt or rolling if planting is done during times of torrential rains. To plant during the months of low rainfall would result in plants being very slow in taking root and the effect of the consequent set back may be visible during the whole life of the plantation. The most important period in the life of a plantation is the first few months after planting. The plants must be brought on quickly so that in as brief a period as possible they become large enough to shade the soil under them. The point stressed here is that it is best to plant when the longest period of good growing weather to immediately follow can be anticipated, just after the period of heaviest rain. In Assam the best period for planting appears to be the month of August.

Cultivation

While considerable emphasis is often laid on systems of cultivation, weed control appears the chief desideratum. A plot of pineapples in which the weeds were kept down entirely by hoeing gave as good results as adjoining areas where the soil between the beds was kept in good tilth by the usual cultural operations. Due to the comparatively poor root system of the pineapple, it does not compete well with other plants and freedom from weeds is very necessary. Light tillage just sufficient to keep down the weed growth and to break the soil surface is sufficient. Deeper cultivation than this only breaks roots and results in the deeper drying of the soil. To deal with the luxuriant growth of weeds during the rainy season may justify or necessitate greater disturbance of the soil but since there is more moisture present not so much harm is done. The roots of the plants maturing fruits, however, must not be broken or disturbed.

Manuring

The growers do not follow usually any systematic manuring policy. In the case of rich virgin soils manures are, as a rule, not applied. In the case of old soils nitrogenous fertilizers and organic manures such as oilcake, cowdung, goat and sheep droppings are used but the practice is not general and common. It is done only by the more progressive growers. It is now admitted on all circles that continuous good cropping is not possible without the application of manure. It is clear that the number of fruitlets is irrevocably determined by the nutrition of the plant up to the time the bud is formed at the growing point, which is sometime before it actually appears. Thus when the plant has been adequately nourished and the growth status is good, there will be a large number of fruitlets and a large pineapple.

Studies have revealed that quite a large quantity of the principal nutrient elements, nitrogen, phosphorus and potash, is removed from the soil by a pineapple crop. Horner[1] estimated that an average of 60 lb. of nitrogen, 17 lb. of phosphoric acid and 212 lb. of potash is removed in 33·2 tons of fruit per acre. In the whole plant at its point of maximum growth he estimates an average per acre of 512 lb. of nitrogen, 112 lb. of phosphoric acid and 1,455 lb. of potash. It is thus evident that to reap a good crop all these elements will have to be supplied in an available form to the plant.

During the preparation of the land or at the time of planting decomposed cowdung and oilcake may be applied at the rate of 5 to 10 tons per acre and a 10-6-10 fertilizer mixture used for later applications. Normally the first application of the fertilizer should be given shortly after planting so as to encourage as quickly as possible a wide spreading leaf growth. Between 30 to 40 lb. per 1,000 plants is the usual amount to be applied. Two or three further applications of 50 lb. per 1,000 plants will be necessary before the crop is picked. The fertilizer may be applied around the soil and worked well into the soil but it can be best

[1] Horner, John M. *A study of the composition of pineapple plants at various stages of growth as influenced by different types of fertilization.* *A. H. P. C. Expt. Sta. Bull.* 13, 1930.

applied by a water soluble mixture placed in the leaf bases. Each plant receives a small quantity which gradually dissolves and becomes immediately available.

Nitrogen may be applied in organic or inorganic forms but a unit of nitrogen in organic form appears less effective and much more costly than in mineral forms. Ammonium sulphate appears to be the pineapple fertilizer *par excellence*. Sodium nitrate does not seem adapted to the peculiar physical needs of the pineapple and it gives usually an off-colour plant. Effect of potassium nitrate is same as sodium nitrate. Calcium nitrate gives fair results but both the above appear inferior to ammonium sulphate. Even ammonium nitrate does not appear quite as effective as the sulphate.

Phosphoric acid may be applied in the form of superphosphate; finely ground bone-meal or basic slag have given good results in field experiments. Potash may be applied in the form of potassium sulphate.

Harvesting

Great care should be taken in picking pineapples when these are intended for a distant market. For Calcutta they should be picked when they show a yellow tinge at the base. A knife should be used for picking and about $1\frac{1}{2}$ to 2 in. of stalk should be left on each fruit. Spines on the leaves should not be allowed to prick the fruits as this may cause them to rot in transit. If pineapples are to be sold at a local market for immediate comsumption these should be allowed to get fairly ripe before they are picked.

Yields

Yields vary considerably and depend principally on the total number of fruits borne, variety, size and weight. On an average 10 tons per acre on the plant or first crop is considered a good yield. But by a little care and attention to methods of cultivation average plant yield has been increased in certain places to about 20 tons per acre. With closer planting, improvements in planting material and culture, the average crop yield has been increased to 25 to 30 tons per acre, with some of the best fields giving 35 to 40 tons.

Care of the field after harvest

After harvest the plants that have given fruits should be cut at the ground level with a sharp knife, leaving the ratoons intact, removed and allowed to rot in compost heaps. The ground should be given a thorough hoeing, weeds buried and soils piled around the bases of the ratoons in order that these might establish an independent root system. Manuring and other cultural operations as for the parent crop should follow as usual.

Pineapple plantations are often allowed to remain five to ten years and a number of crops secured. After three or four years the plants show signs of exhaustion and they must in that case be uprooted and the land prepared for a fresh stock.

Cost of production and profit

Cost of production varies from locality to locality depending on the wages of labour and cost of materials. An average estimate is given below just to give an idea of the probable expenses and returns. The estimate is for an acre of land.

1.	Jungle cutting and clearing ..	Rs.	25
2.	Hoeing	Rs.	50
3.	Planting	Rs.	40
4.	Suckers	Rs.	40
5.	Manure	Rs.	100
6.	Harvesting	Rs.	25
7.	Miscellaneous	Rs.	30

It would appear from the above estimate that the total expenditure comes to Rs. 310. Now taking 4,000 fruits as the average yield per acre and annas two as the average price per fruit the gross return would come to Rs. 500. Deducting the cost of production it is expected to yield a net return of Rs. 190 per acre.

The climate and soil of Assam are particularly suitable for the cultivation of pineapple. Further there are vast tracts of waste hilly lands where the cultivation of this fruit can be profitably extended. The educated youngmen of the province who are interested in agricultural pursuits will find pineapple a very suitable fruit to start with.

GROWING FODDER CROPS ON SEWAGE

By S. C. PILLAI, R. RAJAGOPALAN and V. SUBRAHMANYAN

THE recent decision of the Government of Madras to commend to the Municipal Councils and major *panchayats* in the province to grow fodder crops on sewage is much to be welcomed. Sewage is a rich source of plant food and considering everything, production of fodder is perhaps the safest and the best use that can be made of it. At the same time, there are certain related aspects which would require the careful consideration of the Government and the local bodies concerned.

Points for consideration

We have had experience of sewage farming for over twenty-five years and arising from this, the following would require very careful examination: (1) The area available and its proportion to the total normal discharge of sewage, (2) distance from town, the slope of the land, the mechanical composition and drainage facilities of the soil, (3) the water table and, in certain places, the nature of sub-soil water, (4) the facilities for discharge of storm water, (5) the direction of wind in different seasons, (6) the nature and extent of pre-treatment of sewage with particular reference to the destruction or elimination of fly and mosquito larvae, hook-worm and other undesirable forms of life, (7) the efficiency of oxidation of sewage organic matter and the associated microbial forms and (8) local arrangements for the disposal of night-soil and refuse. These and other aspects would require careful study and this can be best done by the agricultural and health authorities carefully inspecting each site and giving the best possible advice and assistance to the local bodies. Some officers should be specially delegated for this work and it should be their whole-time work to go round the province and give all possible assistance to the local bodies. Otherwise, there will be a lot of cause for complaint from the public. Public health will also suffer.

S. C. PILLAI, R. RAJAGOPALAN and V. SUBRAHMANYAN, D.Sc., F.I.C., are on the staff of the Indian Institute of Science, Bangalore.

Diluted sewage

The present trends of evidence would show that even treated sewage gives the best response only after dilution; that the soil requires liming and periodical rest. Filtered sewage is deficient in phosphate and this has to be made up either by dried sludge or from other source. It is not always possible to dilute sewage, but, more recently we have found that the basin below a sewage-irrigated area holds an abundant quantity of water suitable for dilution. This would offer very attractive possibilities because, by installing a few bore-wells or dug wells in the sewage farm area, it would be possible both to suitably dilute the sewage and to extend the area under fodder crops. If suitably treated and diluted, even other types of crops can be grown on sewage. In this direction the cooperation of the Department of Industries with its expert staff in well boring, will be most useful.

Growing grass on sewage

In the neighbourhood of many towns, the present tendency is to grow market garden crops which fetch a quick cash return. Our experience has shown that such crops are not always dependable. Leafy crops usually do fairly well but even these harbour heavy superficial pollution which could not be completely destroyed by ordinary cooking. These pollutions may not have any immediate harmful effect, but they will produce digestive and other disorders in the long run. Crops grown on sewage usually contain excessive amount of water and tend to perish rapidly on standing.

From the point of view of cash return, grass will, in the long run, be as profitable as, if not more than, market garden crops. Certain grasses are very heavy yielders (50 to 60 tons or more per acre) and several cuttings can be taken in a year. In any town, there is always an assured clientele for green grass. The city of Madura is running a quite successful farm on grass and has scope for making a still bigger success of it. Certain progressive municipalities can also maintain their own herd of milch

and draught cattle on their own farm. Animals are quite resistant to sewage pollution, so, they can be safely reared on sewage-grown fodder.

Sugarcane can be grown on sewage and under favourable conditions quite heavy yields (75 to 85 tons) can be obtained. Unlike the fodder crops, sugarcane requires much attention. The juice contains the expected quantity of sugar, but it also includes certain salts which somewhat affect both the taste and the setting quality if made into *gur* (jaggery). The presence of salts does not affect the manufacture of white sugar, but this would not be possible unless there is a factory in the neighbourhood. The possibility of growing sugarcane still requires careful consideration because of its value as a good cash crop.

The Indian Council of Agricultural Research is maintaining a research unit at Bangalore for the study of problems in sewage farming. Apart from the related fundamental studies this unit has also carried out work at a few select centres for utilizing not only domestic sewage but also industrial wastes (mixed with domestic sewage) for crop production.

AUSTRALIAN CATTLE FOR CEYLON

DURING the war 1,000 cattle were shipped to Ceylon to improve the quality of local herds, and Ceylon intends to import further animals from New South Wales (Australia). This was stated by Mr. St Elmo Wijeyekoon, of the Ceylon Department of Agriculture, who is in Australia to study veterinary science. He said that the cattle were being raised on the highlands of Ceylon where the climate was similar to that of New South Wales.—*Agricultural Newsletter*.

FIG. 1. A portion of the wall which came down after the September rains.

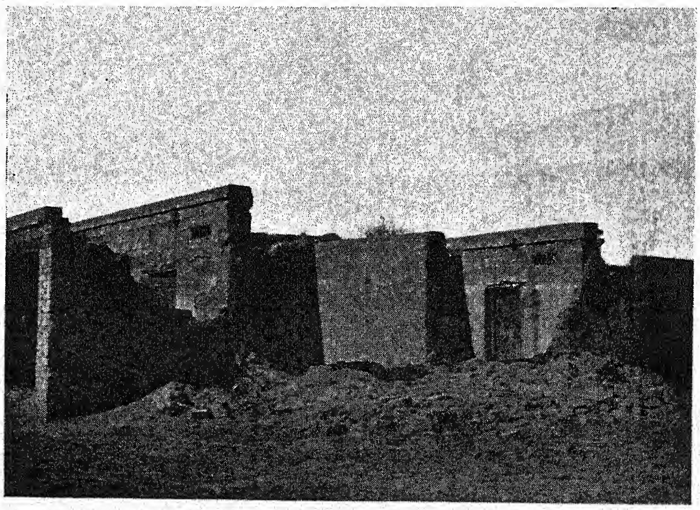


FIG. 2. Fallen ploughmen quarters.

PISE DE TERRE

By P. N. NANDA

IN an article entitled *Pise de terre—A Cheap Method of Enclosing Land or Fields* by Mr. (now Lt.-Col) W. S. Read, published in *Agriculture & Livestock in India*, Vol. IX, Part IV, July, 1939, the author described in detail, the method of constructing pise-de-terre walls, etc. He further stated that such walls were durable and that they were cheaper to make as compared with those made in burnt-brick in mud, with or without cement pointing and also sun-dried brick in mud, with a top course of *pucca* brick. Consequently, a large number of ploughmen's quarters and a segregation wall about 4 miles long was made on Government Livestock Farm, Hissar during the past six years. Each quarter consisted of one room 10 ft. × 10 ft. × 10 ft. with a verandah enclosed on three sides 10 ft. × 8 ft. × 8 ft. Walls were of 15 in. *pise de terre*. All walls and front of verandahs were finished off with a parapet and drip-course of burnt brick. External ends of verandah partitions were faced with burnt brick. Flat mud roofs were built on wooden rafters. Every quarter was finished off with *lapai* plaster. The segregation wall in *pise de terre* was 5 ft. high and 15 in. thick. A 6 in. thick coping was put on in mud and the wall was plastered with ½ in. thick *gobri lapai*. One half of the wall was made through a contractor and the other half by direct labour. The construction in both cases was supervised by a Farm Official who was fully conversant with the detailed technique of this type of construction.

Rai Bahadur P. N. NANDA, M.R.C.V.S. is the Director of Veterinary Services, Bombay.

The cost of the above quarters and wall was comparatively low but unfortunately, this method of construction has not proved satisfactory in that

1. the walls, etc. are very heavily attacked by white ants and therefore need frequent repairs in the form of new *lapai* plaster,
2. the animals damage the walls considerably by digging their horns in the walls,
3. the walls and quarters failed to stand up to heavy rains. There were heavy showers in September 1946 and a large number of quarters and a major portion of wall collapsed completely and
4. the method of construction is not foolproof even under expert supervision, as in actual practice, in spite of the test suggested, it cannot be definitely ascertained if the ramming was sufficient.

It is the opinion of the writer, therefore, that walls, etc. of *pise de terre* are not suitable in cattle farms where horned cattle are reared, white ants are a menace and the rainfall is heavy.

CROP INSURANCE

By V. VITHAL BABU

IN almost all the modern countries, the beneficial effects of a comprehensive policy in the domain of insurance have been witnessed and the facets of industry and agriculture bear coverage of their relative risks. It has been long since realized that to expose both of these productive channels to risks which are not covered by insurance would mean a hot-bed to the National Economy. In fact, insurance has conferred a great boon by minimizing the intensity of the hazards or risks that are attendant on life and property and the insurer can sleep out the thought of risks, for example, death, fire, marine, accident, etc. But we find that insurance against death is being utilized by men with regular and uninterrupted revenue or means; insurance against fire and accident covers the risks of only merchants and traders; marine insurance is a means of compensating the owner of a ship or cargo for complete or partial destruction at sea. All these forms of insurance do not touch even the fringes of the rural people. The agriculturist, on the other hand, is on a different footing and is exposed to natural risks of a very rough order. He gambles in rainfall; hail and windstorms render futile his labours; floods and freezes may do untold damage to his crops. It is against all these risks, that the agriculturist in any country has to be safeguarded and much more so in a country like India, where the bulk of the population is entirely dependent upon agriculture.

Necessity for crop insurance

Examples can be multiplied to show as to how the incidence of 'positive checks' to agriculture have played dangerously in the past, continue in the present and will recur in the future. In the year 1944, the United Provinces was the victim of very heavy rains and ravaging showers of hailstorms destroyed not only the standing crops but also bundles cut and stacked for thrashing; the floodwater reached a level unknown before affecting a total area of 4,767 sq. miles allowing 28,000 houses to be collapsed and affecting 11,22,000 persons in two districts alone. During 1946, over 120 villages with a population of about 300,000 have been affected by floods, considered to be the biggest since 1931, according to reports from Nowgong, in Assam. All these instances point out clearly the necessity for the early introduction of agricultural insurance.

V. VITHAL BABU is Research Secretary of the Congress Party in the Central Legislature.

Crop insurance in Europe and America

We know that in Europe and America, this system is widely prevalent. In Belgium, crop insurance has been found to be of immense help to the rural class. In Greece, it is said, the Agricultural Institute undertakes direct insurance against hail and frost, in addition to the provision for re-insurance of local organization. In France, cooperative institutions consisting of cultivators and also joint-stock companies provide similar facilities with the Governmental assistance in the form of loans as and when contingencies arise. In Germany too, we hear of hail insurance being a prominent bed-rock of agricultural economy transacted by private and public companies.

In passing, let me sketch a simple outline of the policy of agricultural insurance in the United States. The necessity to stabilize agrarian life and protect the peasantry from all the impending frowns of natural forces was realized as early as in 1916, and an attempt was made in 1917 to insure grain mainly in Dakotas, though it took two decades before anything substantial could materialize. It was the year 1920 that witnessed the inauguration of a large insurance company which offered a contract practically ensuring the farmer an income from each acre seeded. Of course, the company lost money on almost all policies, due to the low prices which reigned that year. By 1928, three companies were pursuing in some selected areas and for some selected crops a type of insurance covering droughts, excess of moisture, plant diseases, etc. All these provisions were fully covered in the Title V of the Agricultural Adjustment Act of 1938 which was properly known as the Federal Crop

Insurance Act. According to this, an agency known as the Federal Crop Insurance Corporation, with $ 100,000,000 as its Authorized Capital was incorporated in the United States by the Government. It carries on the policy of affording protection to wheat growers from losses arising out of droughts, flood, tornado, wind, insect pests, etc. Wheat was followed by cotton and flax.

Payment of premiums

The basis of insurance is that the premium the insurer pays will be reckoned in terms of commodity rather than in cash. This means that the premium will be paid in so many bushels of wheat or cotton and the Federal Crop Insurance Corporation would freeze its reserves in the specified commodity. But the practice of paying premiums in their cash equivalents is also prevalent. The idea is based upon the understanding that in 'lean years' the deficits could be easily adjusted from the surpluses of the bountiful years. It was viewed that as a result of this process, it would have two striking effects: firstly, in years of plenty as well as in years of scarcity prices would not earmark a gulf of difference and disparity; and secondly, as premiums paid in the shape of commodity would be reserved to counteract any losses in crops, it will be easier to handle any unforseen circumstances in the most successful manner possible.

New outlook required

A policy of crop insurance is not quite alien to us in India, but it needs only an orientation of the practice of our elders, who never disdain from storing a part of the yield of a particular year. That stock forms the cover against unavoidable and unpredictable catastrophies and would be utilized to tide over unpleasant years. The orientation I was speaking about refers to the fact that while our elders dealt with the simplest form of insurance, which is based upon individual reserves, the new policy will be based upon the structure of general reserves, the principle followed being 'all for each and each for all'.

In our own country, in the Dewas (Junior) State, a scheme is being pursued whereby a type of insurance against the crops to be produced holds its own, and the benefits thereunder would accrue to the cultivator, who owns the land or retains the occupancy rights. The scheme is being successfully carried out with the valuable assistance of the Revenue Department of the State. This Department is of particular interest as it disseminates information in regard to land records of every individual policyholder or *pattadar*, and would be of great help in arriving at the estimation of the percentage of damages of the crops and in specifying the area under damage, etc.

Introducing crop insurance in India

After all this is said, I come to the point whether such a scheme would not be practicable and successful in India. Dr Rajendra Prasad, during the course of the debate on the floor of the Assembly, expressed his fullest admiration for the principles embodied in the policy of crop insurance and referred to the fact that any scheme of insurance in India was an insurance against weather. True it is that weather differs from other risks like death, sickness, fire, etc. and that the degree of uncertainty in weather is beyond all mathematical and meteorological calculations. But still the problem remains as acute as ever, for the major part of our population whose basic occupation is agriculture are directly affected adversely and the people as a whole indirectly due to curtailment in foodstuffs, etc. It is incumbent, therefore, upon the governments, both central and provincial, to deem it their minimum duty to safeguard the proverty-stricken rural people without leaving themselves to their own fate.

It is really a welcome sign that the Food Member will institute an enquiry into the possibility of inaugurating a policy of crop insurance and explore all avenues to make it feasible at an earlier date.

Before any comprehensive policy is outlined, some tests should be undertaken in provinces representing major crops say for instance, wheat and cotton in the Punjab, tobacco in Madras, sugarcane in the United Provinces, jute in Bengal, etc. Secondly, applications should be invited from the particular areas and the Government should see that at least a considerable portion of the farms producing the insurable crop is obtained. Thirdly, a system of 'progressive coverage', which means that the protection would vary with the progress of the growing season of the insured crop, should be embodied in the plan. Fourthly, the Central as well as the Local

Governments should in the first instance pool together the necessary capital and later on the corporation so founded would be cooperatively carried on. In other words, for some years, say not less than five years, the insurer need pay only his premium without having any hand in the management and administration, and after these years, the policy-holders would be compelled to join as the shareholders of the corporation, so that more lively interest is taken by the policy-holder not only to take all protective measures in the event of any contingency, but also to lend a helping hand to his neighbours who happen to be his co-sharers in the corporation's profits and losses. Fifthly, in times of a huge loss of crops, a subsidy may also be drawn from the local government. Lastly, the system of fragmentation of land, which is so proverbial in our country, may seem to frustrate the policy of crop insurance, but it can be to a certain extent avoided if some of the smaller holders of land would combine in tens and cooperatively pay the premiums and conjointly receive the compensation of losses.

Biththî kettarû kedu—bittadê kedabedâ.

Sow the seed though you may not obtain a crop; do not later have occasion to think that you have nothing to reap because you did not sow.

Bijâ ballavâ besayâ ballâ.

He who knows his seeds, knows his job as a farmer.

Samayavarithâ bittanê vayasû bandâ kanyê.

A crop that is sown in time is like a maiden in her prime.—*Agricultural aphorisms from Mysore.*

SOME ODD AND UNUSUAL TREES

By M. S. RANDHAWA

IN this age of plans and standardization, the craving for individuality can easily be appreciated. Every individual desires to have some odd tree in his garden to excite the wonder and curiosity of neighbours and visitors. There are some trees indigenous as well as exotic which satisfy this trait in human character.

Out of these odd and unusual trees, *Cycas* and *Ginkgo* have a special historical and botanical interest. *Cycas* or the so-called Sago Palm is a comparatively common garden tree and is usually mistaken for a palm. It is as much related to a palm as a sea-horse to a land-horse or a shark to a whale. The sea-horse and the shark are fishes and the land horse and the whale are mammals. *Cycas* is nearer to Ferns than to Palms in relationship. Like Ferns, the powder-like pollen produced in male cones produces living motile sperms. Commonly the trees that we notice in our gardens are female plants with woolly female cones bearing scarlet-red ovules. In the Jurassic period when birds were evolving from reptiles there were big jungles of *Cycas* and tree-like Cycads. At present this garden plant survives merely as a living fossil, survivor of an ancient race of plants which dominated the surface of the earth millions of years ago. Similarly *Ginkgo*, or Maidenhair Tree (Fig. 1) which has been saved from extinction by the Chinese priests who gave it shelter in their temples, is also a living fossil. In this tree also we find that motile sperms which actively swim about in drops of water are produced as in animals. While *Cycas* is easy to propagate by means of bulbils, *Ginkgo* which is grown from seed is a difficult tree. In Northern India only in Dehra Dun, it has attained reasonable size.

We may also mention *Araucaria* which is also a distinctive tree in Northern India, and when successfully grown arouses considerable interest among visitors. A native of tropical regions it is kept in pots in cool verandahs. Ornamental bamboos which are so popular in China, particularly the striped gold-with-green variety are also attractive and the soil around them can serve as a base for rockeries.

There are some trees with unusual type of fruits. The cannon-ball-tree has ball-like fruit studded over the main stem (Fig. 2) while the candle tree has candle-like fruits protruding from the stem (Fig. 3) . The sausage tree has sausage-like fruit dangling from its branches (Fig. 4).

There are some trees which have odd and unusual leaves. Ravenala, the Travellers tree from Madagascar, has been grown with success in some private gardens in the moist districts of the eastern United Provinces and in Bihar. It has big banana-like leaves arranged in the form of a Japanese ladies hand-fan (Fig. 5). One of the most peculiar trees is Krishna's Ficus with leaves joined at the base, giving them kulfi-like appearance (Fig. 6). The legend is that Krishna used leaves of this tree for storing stolen butter.

M. S. RANDHAWA, I.C.S., is Deputy Commissioner, Delhi.

A list of unusual trees for the gardens of the curious

1. Angiosperms

Serial No.	Natural order	Botanical name	English name	Indian name	Description	Gardening notes
I.	Araliaceae	*Trevesia moluccane*			A small tree with very large palmate spreading leaves surrounding clusters of dark purple berries.	It is a tropical tree, a native of Moluccas and is suitable for Bengal and tropical South India only.

Serial No.	Natural order	Botanical name	English name	Indian name	Description	Gardening notes
II.	Bignoniaceae	*Kigelia pinnate*	Sausage tree	*Jhar-Fanoos*	A medium-sized spreading tree bearing long pendulous racemes of mottled dark purplish red flowers which appear like candelabra. Its fruits are long and sausage—like in appearance with long cord-like stalks.	A native of tropical West Africa and which is equally at home even in the cold climate of the Punjab. Propagated by seed.
		Parmentiera cerifera	Candle tree	*Mom-Batti R.*	A small tree with light green leaves. Its cylindrical candle-like yellow fruits are borne on the stem and branches in large numbers twice a year.	A native of Tropical America. Propagated by seed.
III.	Malvaceae	*Adansonia digitata*	Monkey breed tree	*Gorakh-Imli*	It is a giant tree with thick smooth trunk with broad base and tapering stem. During hot weather it is leafless, when its much divided crown appears gaunt and grotesque. Introduced in India by the Arabs from Africa.	Raised from seed. Planted singly in parks.
IV.	Myrtaceae	*Couroupita guianensis*	Cannon-ball-tree	*Tope-Gola R.*	A remarkable tree with large pink and white fleshy flowers borne on the main-stem. Its fruits are large, brown and globular, about the size of a man's head, resembling a cannon ball.	A native of Tropical South America also found in Ceylon. It flourishes only in a moist tropical climate; propagated by seed.
		Careya arborea		*Kumbhi*	A common forest tree in the C. P. Its copper-red leaves appear very pretty in the month of October. Fruit is pitchershaped; hence the name Kumbhi. Flowers Pink-white. Appear with new leaves in April-May.	Raised from seeds. Planted singly in parks.
V.	Scitamineae	*Ravenala madagascariensis*	Travellers tree	*Khajur Pankhi R.*	A remarkable tree which appears like a gigantic ladies hand-fan. Its big banana-like leaves are borne in two rows. It grows to a height of 30-40 feet. Its sheathing leaf-stalks form receptacles in which water is stored.	Requires a hot and humid climate being a native of Madagascar though in the United Provinces it can grow in shaded and sheltered situations.
VI.	Urticaceae	*Ficus Krishenae*	Krishna's Butter-cup	*Makhan Katori R.*	A small tree with folded leaves joined at the base which appear like containers of ice-cream (Kulphis).	Grows easily in North India.
	2. *Gymnosperms*					
VII.	Cycadales	*Cycas revoluta*			A remarkable tree which produces a crown of palm-like leaves every year. The sexes are separate. The pollen of male cones produces living motile sperms as in Ferns and animals. A living fossil.	Propagated by bulbils.
VIII.	Ginkgoales	*Ginkgo biloba*	Maiden-hair tree	*Bal Kunwari*	A native of China; beautiful foliage and motile sperms. A living fossil.	Propagated by seed.

A CASE OF INDUCEMENT OF LACTATION BY THE ADMINISTRATION OF OESTROGENIC HORMONES

IN the dry herd of the Indian Dairy Research Institute, Bangalore, six Sindhi pure-bred heifers between the ages of three and four had not shown signs of oestrum nor taken the bull. These animals were submitted for a course of treatment with Stilbestrol Dipropionate (M & B), the oestrogenic hormone in oil on 27 March 1946.

One of these heifers—a four years old Sindhi instead of showing signs of oestrum within a week as was expected after the injection, exhibited mammary development. With a dairyman's interest of obtaining milk from her, the udder was manipulated to induce lactation (a sort of pre-milking). She showed milk secretion and at the first attempt she yielded nearly a pound of cholosteral fluid tinged with blood. With continued endeavours, a recordable daily yield of 2 lb. of milk was obtained within a week, since the heifer first showed signs of lactation. But, the milk was invariably found tinged with blood for nearly a fortnight after which it assumed its normal colour. A few milk samples despatched periodically to the laboratory were reported to be of normal quality. The animal was put on special feeding and is milked thrice daily, the milk yield has gradually increased and at the end of 11 weeks her peak yield was 19 lb. with an average 17·14 lb. per week day. She is in her 21st week of lactation and even now her average milk yield is 15·3 lb. per week day. She is now 132 days in milk and has yielded 1,717 lb. so far.

During this period, the animal was given a reinforcing dose of 3 c.c. of Stilbestrol Dipropionate on the 41st day intramuscularly and another dose of 1 c.c. on the 62nd day intradermally in the caudal fold to facilitate show absorption. The progress of lactation is under continued observation and it appears as if she would carry on the full lactation period before she dried up.—I.D.R.I.

You ask We answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. I am very much interested in the canning of oranges. Can you tell me if any suitable method has been evolved for the successful canning of orange? How is the flavour in the canned product fortified ?

A. A method for the successful canning of oranges (Malta and Sangtra) had already been evolved in the Indian Institute of Fruit Technology, Lyallpur as a result of research work carried out on this problem, in the scheme for special work on fruit and vegetable preservation. Cut out tests of the products canned in this connection, were continued in the Institute and these confirmed previous findings. Further work, carried out in connection with this problem, under the Institute, consisted of (i) artificial fortification of flavour in the canned product, and (ii) varietal trials for the selection of good canning varieties.

Experiments on fortification of flavour: To find out the best essence, eighteen test lots of oranges were canned in preliminary experiments in which different doses of orange oil, combination of orange and lemon oils, essence 'Vita Crush', etc. were added. The experiments indicated that the addition of oil imparted terpenous odour to the product, while essence 'Vita Crush' added to the canning syrup at the rate of 0·5 gm. per lb. of syrup, satisfactorily improved the flavour.

Varietal trials and storage tests of flavoured lots: Four varieties of Malta (namely Common, Blood red, Jaffa and Pineapple) and two of Mandarin (Sangtra *desi* and *Nagpuri*), were canned in winter in 1945, according to the method already standardized, to test their canning quality. About 550 oranges collectively of all varieties were used for these experiments. All varieties were canned in A2 plain cans, using a canning syrup of 55° Brix concentration, with and without the addition of essence 'Vita Crush' to it, at the rate of 0·5 gm. per lb. of syrup. The cans were exhausted for twenty minutes at 175 to 180°F. and sterilized for 30 minutes at 180° to 185°F., followed by cooling as usual.

Cut out tests of the twelve lots thus prepared were carried out as usual twice, during a storage period of one year. These tests revealed that all the varieties yielded good products, which showed a satisfactory behaviour during storage. Addition of essence 'Vita Crush' used for fortification of flavour has also given good results, without imparting any terpenous odour to the product, during the above storage period.—I.C.A.R.

What's doing in All-India

BOMBAY

R. S. DUBHASHI

THE Livestock Section kept 749 premium bulls and 1,688 premium cows in various districts of the Bombay Province, for the production of the pedigree stock of bulls and cows. There are 11 farms which produce 175 to 200 bulls annually of the breeds of Kankrej, Amrut-mahal, Gir, Dangi, Nimar and Khillari. The general improvement in respect of (1) milk yield, (2) stamina, (3) type, (4) early maturity and (5) regular calving is perceptible particularly in the districts of Sholapur, Ahmedabad, Dharwar, and Nasik. The premium bulls are given out with a feeding allowance of Rs. 10 each bull per month.

Of late, cattle breeding centres each consisting of five villages with five breeding bulls and fifty cows have been organized at 22 places. This scheme is restricted to Khillar, Amrut-mahal, and Kankrej breeds only for the present. The *goushalas* and pinjrapoles actively co-operate with the Government in this matter. Cattle breeding societies have been established at Sanand, Mahud, and Rajur. Cattle shows are held every year at Mahud, Sanand, Rajur, and Haveri.

Milk supply

The milch buffaloes are the chief source of milk supply in the province. Thirtyseven buffaloe premium bulls are kept in the districts of Kaira, Surat, Khandesh, Sholapur and Bijapur for the improvement of the Surti and Pandharpur milch breeds. Under the Palghar Dairy District Scheme for the improvement of milk supply to Bombay city, lands measuring 500 acres in all have been given to four institutions for starting dairy scheme.

Very recently the Government of Bombay have initiated a dairy development scheme for starting dairies in all suitable areas in the province.

R. S. DUBHASHI, B.AG., is Vegetable Extension Officer in the Agriculture College, Poona.

Poultry

There is one Central Poultry Breeding Station at Kirkee and two at Dhulia and Dharwar. The work in Kirkee is in regard to White Leghorn, Rhode Island Red, Black Minorcas and Turkey; 300 breeding stock and 2,000 hatching eggs are supplied every year. The Dhulia and Dharwar Poultry Farms also supply 200 and 300 breeding stock respectively every year. This activity is concentrated in the districts of Sholapur, Satara, Poona, Khandesh and Belgaum.

Sheep

Research in the improvement of the Deccan breed by the Merino sheep and the quality of the wool is carried on at Poona, with extension schemes at Pandharpur, Athni, and Bijapur. Thirtythree rams are placed in the villages adjoining Anagwadi in the Bijapur district. The wool obtained from these improved breeds is soft and people have been taught to handle soft wool at Ibrahimpur in Bijapur district, Mahud in Pandharpur and Underwadi in Bagalkot.

Vegetable Extension Scheme

In August 1942, a scheme for the production and supply of vegetables to the military in Bombay Province, since known as the Vegetable Extension Scheme, was launched. The objects of the scheme were (1) to make the vegetables available to the Army at prices covering the actual cost and ensuring the growers a fair economic return without the intervention of the middle-man, (2) to stabilize the prices by making available to the civil markets when and where necessary at controlled rates sufficient quantities of vegetables with a view to check the soaring prices and profiteering and (3) to provide requirements without encroaching upon the normal civil sources of supply. The scheme which was first started in Poona, Nasik and Ahmednagar districts was later on extended to Belgaum, Satara, and Surat.

Definite zones embracing a group of 5 to 10 villages with 100 to 150 vegetable growers in each zone were organized. There are at present 15 such zones.

While extending the area and supplying vegetables to the military, the work of supplying vegetables to the civil population was also taken up as early as September 1943 by organizing a zone at Surat for supply of vegetables to Bombay civil population through the Government grainshops. Later, in 1945 a move was made to organize a stall in Poona market for supply of vegetables to the civil population of this city.

The area extended was in addition to the area that already existed and was planted with varieties of vegetables according to military requirements. The military requirement of vegetables is made up of four classes as follows:

A class—Beans, cabbage, cauli-flower and peas. (20 per cent).

B class—Beets, carrots, turnips, tomatoes, knolkhol, ladies-fingers, lettuce. (30 per cent).

C class—Brinjal, sweet potatoes, radish, celery, and spinach. (20 per cent.)

D class—Cucumber, marrow pumpkin. (20 per cent).

The scheme is one of production and supply and as such all technical help in the matter of supply of good seeds, manures, insecticides, crude oil for running oil engines, procurement of oil engines for new areas, electric pump connections, etc. was freely given. Cultivators could get the average market prices or the minimum guaranteed prices which were worked out for each crop on the basis of cost of cultivation plus a fair margin of profit to the grower. Regular cropping plans showing planting of vegetables fortnight to fortnight for a continuous supply of vegetables were given to the cultivators.

A total area of about 3,000 acres is registered in each season in all the zones taken together. The daily supply of vegetables to the military rose from 25,000 lb. in October 1942 to 83,000 lb. in 1945 and now it is about 56,800 lb. per day. The scheme includes onions also and now a quantity of about 52,000 lb. onions is supplied daily to the military. The quantity of vegetables supplied from Surat, Poona, and Nasik to the civil population of Bombay through the Government grainshops averages to 19,000 lb. per day.

Cooperative societies were taken advantage of in almost all the zones and new ones were formed wherever there were none. The scheme has helped the societies to build up funds which can be used now in the post-war period for marketing.

Though the scheme was initiated at the instance of the military authorities it has given the Department of Agriculture an idea as to how to plan out the work of vegetable extension which is so essential from the nutritional point of view. The scheme has benefited the cultivator and has been a great success.

Potato storage and supply scheme

The potato storage and supply scheme was organized in November 1942 with the main object of producing potatoes for supply to the military. Later on, this scheme was expanded with a view to meeting the requirements of the civil markets in Poona, Satara, Nasik and Ahmednagar districts and Bombay.

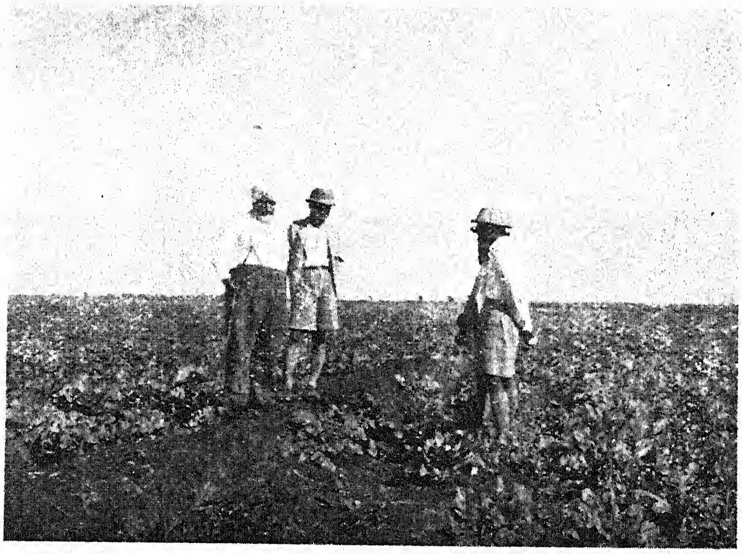
Under this scheme potatoes are grown under contract with the cultivators who are supplied their requirements of seed potatoes at a concessional rate on their undertaking to sell out their entire produce to the Government in three or four equal instalments and at rates previously fixed with the cultivators. No middlemen are employed for making purchases.

Potato markets have been organized in Poona, Ahmednagar, Satara, and Nasik districts for the convenience of the cultivators. The potatoes are graded, weighed and ultimately transported to the Central Storage Depot at the Agricultural College, Poona.

The scheme has been a great success and a net profit of over Rs. 10,00,000 has been obtained by the Government during the period 1942-1946.

Horticulture

Seven district nurseries financed by the Rural Development Boards were established at Nadiad, Dohad, Niphad, Puntamba, Nandgaon, Bijapur, and Dharwar. These nurseries supplied a large number of budded and grafted plants to the cultivators. The Ganeshind Fruit Experimental Station at Kirkee, the fruit garden at Modibag and the Padegaon research station also supplied a large number of plants to the cultivators. Besides, 19,200 shade trees seedlings



Cabbage and cauliflower crops grown under the Vegetable Extension Scheme.

PLATE 48

were distributed free to cultivators on Arbor Day organized by the various district Rural Development Boards. Large plantations of mango bud grafts are being laid out in Gujarat and Deccan.

Construction and improvement of wells and tanks

In order to implement the 'grow more food' campaign, the Government has sanctioned a special scheme for the construction of tanks and wells. Under this scheme the cultivator is given financial help in the form of subsidy or *taccavi* as follows:

Item	Average cost	Subsidy help	*Taccavi* help
Construction of a new well or tank	Rs. 1,500	33 per cent of total actual cost	67 per cent of the total actual cost
Improvement of old tank	Rs. 500	50 per cent of total actual cost	50 per cent of the total actual cost
Improvement of old wells	Rs. 300	50 per cent of total actual cost	50 per cent of the total actual cost

The cultivator who is benefited under this scheme is expected to grow only food crops and to irrigate at least five acres of food crops under a new well and three acres of food crops under an improved well.

Under this scheme 15,600 applications have been received so far. Out of this the construction of 3,441 new wells and the repairing of 3,003 old wells have been taken up. The total cost of the scheme is expected to come to Rs. 5,416,665.

Boring of wells

The scheme was originally put into operation in 1944 but has been augmented since March 1946. Under this scheme 16 boring machines (9 hand boring and 7 power boring) are to work in the nine districts of the province, viz. Ahmednagar, Kaira, Thana, Poona, Sholapur, Dharwar, Nasik, East Khandesh, and Ahmedabad. The number of bores taken up to date is 83 with a total of about 4,500 footage. The casing pipes, if required for these bores, are supplied at controlled rates.

COCHIN

C. S. VENKITASUBBA IYER

SINCE the outbreak of the war the people of Cochin have been exhorted by various methods of propaganda and concessions to grow more food. The return of peace instead of bringing the expected relief has only worsened the food situation. The slogan 'digging for victory' needed amplification and larger concessions to ryots became imperative. It must, however, be borne in mind that food had always remained a matter of serious concern in Cochin whether it was war or peace time. Briefly stated the State was producing only less than half her requirements of the staple food, e. g. rice and practically little of pulses and was dependent on Burma and British India to feed her. The war and the resulting world shortage in food has only served to emphasize this dependence of the State on foreign imports.

C. S. VENKITASUBBA IYER is Special Officer, Vegetable Production in the Cochin State.

'Grow more paddy'

From the commencement of 1946 the subsidy in the selling price of manures to be used for paddy and other seasonal crops as vegetables was trebled from twentyfive per cent to seventyfive per cent of the cost price. The *kole* paddy crop is usually unmanured since the fields are kept fairly fertile through the annual accumulations of silt in the rainy months. But these deposits which are progressively declining in quantity fail to meet the needs of the crop and manuring has become necessary for normal yields. Still the majority of the cultivators stick to the time-honoured practice of not manuring these fields at all. Vigorous propaganda was carried out during the last season and some 1,400 acres were got manured in the months of February and March 1946. One hundred and fifty tons of groundnut cake was used for this purpose and the cake was transported free to the fields of the ryots. An

increase of 8,00,000 lb. of paddy was obtained as a result of this manuring. This campaign would have embraced a larger acreage, but the dearth of irrigation water and absence of rain severely restricted the operation.

In the Malayalam year 1121, manures worth three and a half lakhs of rupees were sold to ryots at subsidized rates.

The larger concessions embraced the subject of agricultural implements also. Since the commencement of 1946 about Rs. 1,14,000 worth of essential implements have been fabricated and distributed to the growers at nominal rates.

'Grow more vegetable' campaign

The inauguration of the Vegetable Extension Scheme was however the most noteworthy feature of the period since the start of the year 1946. A campaign for the growing of more vegetables was commenced in April 1946 with the definite objective of bringing five thousand acres as additional acreage under vegetables within a period of twelve months from 28 March 1946. To attain this target the following concessions have been offered to the growers:

(1) Free supply of seeds and seed materials.

(2) Free supply of highly concentrated vegetable manure to the growers, at the rate of 25 lb. per grower. Further quantities requisitioned will be sold at fifty per cent of the cost price.

(3) A subsidy of Rs. 25 per acre for putting up fencing and Rs. 25 per well for deepening and silt-clearing of wells.

A special staff has been appointed to conduct the campaign, the most noteworthy feature being the appointment of a technical hand to supervise and direct the cultivations in each *panchayat* area, which on the average measures only ten square miles in extent.

In the period of four months from the inauguration of the campaign Rs. 20,000 worth of seed and seed materials and Rs. 15,000 worth of manures have been distributed absolutely free to growers. Subsidies amounting to Rs. 4,000 have also been distributed to growers for fencing. An additional acreage of one thousand and five hundred acres has been achieved within these four months when the campaign has only just commenced to gain momentum.

New insect pests

The army worm *Spodoptera mauritia* Boisd has hitherto been infesting paddy in the seedling stage only. When the crop has grown forty days old and over it is considered to be no more vulnerable to the pest. But during the last *kole* season in March-April the pest sprang a surprise by attacking fields in which the crop had attained a growth of about two months, with the earheads just about to emerge from their sheaths. The plants were reduced to tall club-like stumps, the sheath being pregnant and bulged with the earheads inside. The attack resulted in heavy loss of crop yields. If the army worm is to repeat this behaviour and acquire the habit of attacking older plants its control becomes more difficult than hitherto.

A new pest has appeared in arecanuts. This palm had few insect enemies, scales being the only trouble noted on young plants. But in August 1946, a garden was found to be severely attacked by a caterpillar which bored into the tender nuts, and fed on the kernel within. Attacked nuts were practically hollowed out. Pupation takes place on the surface of the nuts in a cocoon built of grass and silk. About fifty to seventy-five per cent of the fruits in a bunch consisting of three to five hundred nuts was attacked and destroyed. The pest is under study and investigation.

Agricultural shows

Two agricultural exhibitions, and one cattle show were conducted in the State during the period January 1946 to September 1946.

The Agricultural School, Central Farm

Since 1946, two different batches of candidates have been trained in agriculture in this School. Twenty candidates belonging to the military services were imparted training for a period of six months. Further a batch of ninety clerks recruited for service under the *panchayat* was rendered instruction for a period of three months. The idea in training this personnel is to provide a liaison between the agriculturists in the rural areas and the officers of the Agricultural Department.

FIG. 1. A vegetable plot under the 'grow more vegetable campaign' showing brinjals, tapioca, plantain, *bendai*, etc.

FIG. 2. (Left). *Bendai* plant.

FIG. 3. (Below). Cowpea.

FIG. 4. Chilly.

FIG. 5. Brinjal.

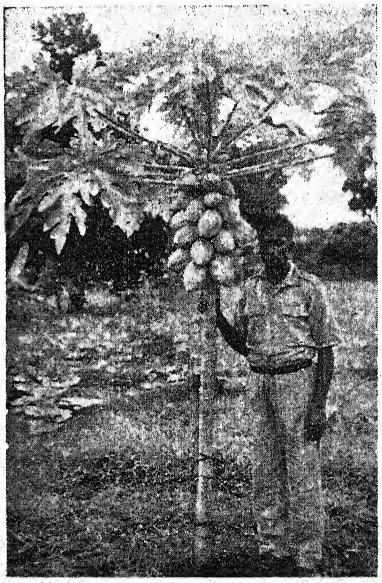


FIG. 6. Papaya.

PUNJAB

KARAM RASUL

DURING July, the first month of the quarter ending 30 September 1946, widespread rains, normal to above normal, were received throughout the province except parts of Jullundar, Mianwali and Rawalpindi districts where rain was below normal. There was, however, no rain in Toba Tek Singh and Shorkot tehsils of Lyallpur and Jhang districts respectively.

In the month of August rain was below normal and in September the weather was practically dry throughout the province.

From the meteorological data recorded at the Lyallpur Agricultural Farm, the weather during the quarter under review was more hot and dry than the corresponding quarter last year.

	1945	1946
Mean maximum temperature	95·16°F	101·05°F
Mean minimum temperature	79·65°F	79·95°F
Rain-fall ..	3·578″	1·34″
Relative humidity ..	76·66	51·9

Floods in the river Ravi and Sutlej caused damage to crops in some villages in Amritsar, Gurdaspur, Lahore, Sheikhupura and Ferozepur districts.

Crops

The area under sugarcane in the British Punjab, according to the second forecast of the crop, has been reported to be 594,200 acres which is almost equal to the corresponding forecast last year but is higher by three per cent than the actual area of last year. While rain in July and August benefited the crop, in the barani areas it was not up to expectation due to abrupt cessation of rains in September. The condition of the crop was, however, normal to above normal in irrigated areas and normal to below normal in barani areas. On the whole the crop remained free from any wide-spread insect pest or disease during the quarter under review. However, Pyrilled borer and Pyrilla are reported to have badly damaged sugarcane crop in some parts of Jullundar district. On account of the phenomenal high price of *gur*, the crushing of the cane was taken up by some cultivators as early as the end of September.

The cotton crop progressed well and rains in July and August proved beneficial to the crop. The crop was practically free from any serious attack of insect pests, but the dry spell of weather in September was apprehended to affect the opening of bolls adversely.

According to the first forecast of the rice crop, the area under rice is reported to be about 13 lakh acres which is the same as the actual area of last year. The attack of stem-borer has been reported from some parts of Dera Gazi Khan district, but the condition on the whole is reported to be 97 per cent of the normal.

The sowing of *chari*, *bajra* and maize crops was taken up in time with rains in July and August, but they did not make satisfactory growth in September due to scarcity of rains, which resulted in a general shortage of green fodder during this month.

The area under sesamum crop, according to the second crop forecast, is about 96,000 acres which is five per cent higher than the actual area of last year and the condition of the crop is reported to be 94 per cent of the normal.

Movement of prices

Taking the Lyallpur market as the basis, the prices of important agricultural commodities during the quarter under review were higher than those of the corresponding quarter last year. Of all the commodities the prices of *gur* and *ghee* were extraordinarily high which probably have never been attained in the history of these commodities in the Punjab. The prices of some agricultural commodities in the quarter under review as compared with the same quarter in 1945 are given below.

Commodity	Quarter ending September 1945	1946
Wheat	Rs. 8-10 to 8-14	Rs. 9-10 to 9-14
Gur	Rs. 10 to 12-8	Rs. 22 to 25-8
Toria	Rs. 14 to 15-8	Rs. 16-8 to 17-8
Wheat *bhusa*	Rs. 2-7 to 2-11	Rs. 3-6 to 3-10

KARAM RASUL, B.SC., AGRI. (Pb.) ASSOC., I.D.I., P.A.S., is Associate Professor of Agriculture in the Punjab Agricultural College, Lyallpur.

In spite of its good production in the last season gram, one of the important commodities, is very scarce in the market.

Miscellaneous

In connection with the 'grow more food' campaign the various schemes such as green manuring, compost-making, well-sinking and Iron Scheme in which iron for hand tools, etc. and big implements are supplied to the farmers are being operated by the Department of Agriculture with enthusiasm and zeal and are proving beneficial to the cultivators. The supply of irrigation water being one of the most important and limiting factors in crop production, the Punjab Government launched a tube-well scheme in which the Government would defray half the expenses of installation of the tube-well. The scheme is receiving very warm reception from the farmers.

With a view to pushing up the cultivation of sugarcane in the province and to give an impetus to the post-war schemes of the Department, a Sugarcane Commissioner and an Officer on Special Duty for planning have been appointed.

Among the various post-war development schemes of the Department of Agriculture, the extension of the Agriculture College and Research Institute at Lyallpur deserves special mention.

BARODA

T. V. MULYE

BARODA has been keeping abreast with other provinces with regard to the improvement of crops and carrying the results of research to the door of the cultivator. The territory is scattered and is divided into five districts and thus provides a separate problem for each district. The major crop, viz. cotton, received the first attention and the old *Ghogari* mixture has been replaced entirely by *Suyog* in Navsari district and *Vijaya* in Baroda district. *Wagattar* cotton was then introduced in Mehsana district and subsequently in Amreli district. In 1938 a scheme to improve *Mathio* cotton of Kathiawar was started. The work resulted in the selection of S31 named as *Pratap*. Extension of this type is now undertaken in collaboration with the Indian Central Cotton Committee and the neighbouring States of Bhavnagar, Junagarh and Palitana. Thus the new type will replace the *Mathio* mixture to an extent of 6,00,000 acres.

Insect control

The Entomological Section is always watchful to protect the crops against the ravages of insects. Cotton semi cooper used to destroy the cotton crop completely in its early stages. After studying the pest a simple method to eradicate it completely was adopted. This consisted in delaying the sowing of cotton crop by about a fortnight and thus deprive the pest of its food. The pest has now almost disappeared.

T. V. MULYE is Technical Assistant to the Commissioner of Agriculture, Baroda.

'Grow more food' campaign

In addition to the various measures in supply of high quality seed and bringing the waste lands under cultivation, the Baroda Government concentrated its attention to improve crop production by increasing the soil water content and productivity by judicious manuring. To achieve the objective, use of water from State-owned wells and tanks was permitted. In addition to this, a plan to have 800 new wells every year was undertaken. In the year 1944-45, 600 wells were thus constructed to have 2,120 acres under double cropping for food. Another programme in conserving the soil water content was to save land from erosion; anti-erosion work covered some 2,400 acres. Further work is in progress.

Oilcakes at reduced rates were issued to the cultivators, the concession being 25 per cent in cost of cake when applied to irrigated wheat and 50 per cent when it was shown that the cake was used for the cultivation of *bajra* and wheat as against use of cotton crop. In the same way, 33 per cent rebate was given in the use of ammonium sulphate for paddy.

Across the Borders

CROPS WITHOUT SOIL

By D. P. HOPKINS

AT a time when the newspapers are crediting chemists with mircales almost daily, yet when headlines in other columns deal with such matters as famine and starvation, it is understandable that every popular reference to soilless cultivation or 'hydroponics' captures the public imagination. Here, it would seem, is a new way of creating food, an extra production line. Two questions, however, must be raised even when famine stalks the world. Is there actually a shortage of soil? Alternatively, does the hydroponic method give superior results to normal soil cultivation methods? And the qualification 'superior' must take into account the economic factor of production cost; for food must be 'cheap' or at any rate within the purchasing powers of poor people as well as rich.

Principles of hydroponics

A plant's own food needs are derived (a) from the atmosphere and (b) from the soil. A great deal of a plant's structure is, indeed, built up from carbon, oxygen and water, all derived *via* carbon-dioxide, air and rain. The soil's particular contribution is to provide (usually with fertilizer or manure help) such nutrients as nitrogen, phosphorus, potassium, calcium, magnesium, boron, manganese, sulphur, and so on. Humus is needed in the sense that it is a 'food' for the soil, a material which will in many ways maintain the various fertility processes that must occur in the soil before plants can draw efficiently and steadily upon the soil's contents. If we eliminate the soil as a medium for nutrient-handling, then we also eliminate the humus requirement. A dilute aqueous solution of the nutrients normally supplied by or *via* the soil can replace the soil. Nor is there anything new or revolutionary in this. In agricultural laboratories 'water culture' and 'sand culture' have been used as methods of investigation since about 1860; by such methods Liebig's main principles of mineral or chemical nutrition were studied in detail, and the relative importances of this or that element were evaluated. But there is perhaps more than a touch of the 'ivory tower' attitude in the fact that the first attempts to adopt these laboratory methods for actual crop production were made only as recently as 1929 by Dr W. F. Gericke, an American scientist. To the historical fact there should be added a geographical fact—Dr Gericke carried out his work in California. As will be seen later, this has had a considerable bearing upon the recorded progress of hydroponic or soilless cultivation.

There is some controversy concerning the use of the somewhat cumbersome word, 'hydroponics'. Pioneers in the field claim that only one of the several systems of soilless cropping is actually hydroponic; unfortunately the different authorities claim this honour for different systems. The all-embracing title of 'soilless cultivation', therefore, is less likely to distress expert sensitivities.

Seedbed as a nutritive medium

Dr Gericke's successes have been mainly achieved by working with nutrient solution reservoirs. Above the solution level—but leaving a space for air—a porous mat of some kind of vegetable litter acts both as a seed-bed and a physical support for the plants. The plants' roots hang down into the solution. Lest the organic-minded should assume from this brief account that the vegetable litter itself contributes to plant-growth, it should be added that, although such materials as peat or leaf mould are very serviceable as litter components because they are easily obtainable and are efficiently porous, much more inert materials such as sawdust, straw, and forms of silica, have been successfully used. A fundamental condition for success is the provision of a seedbed which will hold moisture but not hold it to such an extent that there is little room left for aeration. Nor is the seedbed considered to have no value as a nutritive medium. Dr Gericke recommends the addition of nutrients to the moist seedbed to cover the transition period during which plants are developing a more

complete dependence upon the nutrient solution below; for shallow-rooted crops this is indispensable and for deep-rooted crops it is useful in as much as it helps to develop lateral roots which will provide a stronger anchorage for the plants.

Greater supply of nutrients possible

When the severe losses of fertilizers in the soil are considered, particularly the loss of nitrogen by leaching and of phosphates by fixation, this alternative method of cultivation would seem to possess a very real advantage over agriculture. Not only can these losses be avoided but a greater supply of nutrients in the same space can be given; to quote Gericke, a cubic foot of nutrient solution gives approximately six times the amount of nutrients (and water) that will normally be held by a cubic foot of soil. Of course, the concentration of the nutrient solution that can be used is limited by osmotic pressure consideration—too strong a solution could extract water from the plant and cause wilting—just as in agriculture or horticulture the rate at which soluble fertilizers may be added is limited; but such an abundance of water is always present that this danger is quite remote.

Need for an effective nutritive balance

The principal problem with nutrient solutions is the arrangement of an effective nutrient balance. Gericke has classified the nutrients into three groups: (1) those which are needed as major plant foods and of which the plant will take up excesses if available, (2) those which will not be taken up in excess but only according to need, and (3) those which are needed in small amounts and excesses of which might be toxic. The grouping of the various nutrients in this way follows the well-known pattern of soil chemistry. Group 1 comprises nitrogen, phosphorus, potassium, calcium and magnesium; Group 2 is sulphur only; Group 3 comprises boron, iron, manganese, copper and zinc. It is beyond the general aim of this summary to discuss actual formulae for solutions, but the practical basis for designing effective nutrient balances would seem to be a compromise between (a) the actual nutrient balance in the known composition of a well-grown plant, and (b) the plant's tendencies to absorb Group 1 nutrients too readily. For example, nitrogen might be abnormally taken in as compared with other nutrients so that a partial supply of nitrogen might be advantageous in the initial balance, with a further supply to be added at some later stage of solution adjustment. Obviously the trace-supply of the potentially toxic nutrients must be carefully controlled within known boundaries. Subject to these safeguarding principles, Dr Gericke's early work established that nutrient concentrations did not have to be meticulously accurate in the decimal-point sense, although the laboratory exponents of water culture tests had always supposed this to be necessary.

Economics of hydroponics

On theee general principles—though, of course, with much trial-and-error attention to practical and subsidiary details—Dr Gericke successfully raised innumerable kinds of plants–potatoes, tomatoes, the root vegetables, the cereals, cotton, sugar-beet, herbaceous flowers, tuber and bulb-flowers, and so on. He has recorded an extensive catalogue of cultural achievement. The question is, how does soilless production compare with normal production?

Capital: First, there is the capital outlay. Gericke's estimate (pre-war) is that an acre of basin-space costs 50 times the normal price of an acre of farm land. In special cases, of course, this kind of comparison may not be valid; there may be the personal condition that suitable land is not available at the spot where cultivation is desired, or there may be a more general and geological condition that the soil available is not capable of use for agriculture. But against the background of normal agriculture in temperate countries this comparison of initial 'overheads' has to be faced. The figure given by Gericke is obviously a very rough guide. There is no fixed average cost of land if we take into account the all important variation of inherent fertility; and the cost of the materials and labour used in constructing a series of tanks or basins will vary according to economic factors that are 'outside' agriculture. Little more can be said except that it takes much more capital to set up a 'hydroponicum' than to acquire a similar area of soil.

Yield: Clearly, then, area for area, soilless cultivation must produce much greater yields. Here the nutrient solution method possesses one great advantage over soil cultivation. In

the soil plants must be spaced so that each root system has a large enough ' zone of occupation ' within which to acquire its food supply and moisture; and also, in practice, within which to compete in this task with alien weeds. But when each plant has its root system dipping into a complete nutrient solution, the concentration of which can be maintained or adjusted at any time, there is theoretically no need for lateral spacing; in a condition of nutrient abundance root proximity does not create competition. In practice, the closeness with which plants can be packed in the litter-bed above the solution depends upon (a) the effect of the degree of closeness upon harvesting operations, and (c) the effect of this closeness upon the supply of light to the plants.

Dr Gericke compared soilless results—for his particular climatic conditions—with agricultural or horticultural results by grouping crops as follows: those which cannot be packed more closely than in soil culture, such as most of the farm cereals and sugarcane; those which can, such as potatoes and most of the gardener's vegetable crops; and those which can be mixed cropped closely so that the total cropping per unit of area is greater than the normal rate of cropping from soil. And it is within this third group, by mixed or multi-cropping, that the most impressive results have been recorded.

The success of multi-cropping depends upon choosing partner crops which will not compete for a full light requirement at the same time. Clearly this sort of arrangement is only likely to be effective when the local climate enables plants to develop rapidly and when the light supply is consistently strong, conditions far more attainable in California than in Britain. In two experiments quoted by Gericke, with the yields expanded into a per-acre basis, 40 tons of potatoes and over 200 bushels of sweet corn were grown; and 50 tons of potatoes and 100 tons of tomatoes.

There may be more economic scope for soilless cropping in the specialized horticultural field. Gericke has pointed out that the comparison of initial outlay charges is much less if made against the normal costs of setting up greenhouses and greenhouse beds; and if under glass and with artificial heat crops are grown for specialized and 'out-of-season' prices, hydroponics may successfully compete with the soil-based nurseryman. One cannot help reflecting, however, that the presence of so much moisture under glass could in practice lead to favourable conditions for many troublesome leaf-and stem-gungoid diseases, the control of which might then introduce a fairly heavy running cost.

But, whatever method of cropping is adopted, it seems certain that the soilless cultivator must inevitably choose crops that obtain a high market price. This indicates, therefore, that hydroponics is unlikely to compete with agriculture; but that it cannot be ruled out as an effective method of producing market-garden foods, glasshouse crops, and flowers. Nevertheless, this is a limited summing-up in which the background of comparison is an active cultivation of a fertile natural soil.

Scope for hydroponic farming in tropics

What of regions where there is all the light intensity required for closepacked soilless culture yet where the soil is often of low fertility or even of no useful fertility at all? In *Science for the Citizen* Professor Hogben suggested that setting up of hydroponic tanks in the Sahara desert; and a joint consideration of India's food situation and the poor cropping capacity of much of her soil points to an enormous opportunity there for hydroponic 'farming'. In many parts of the world where the sun's light and heat is particularly favourable to hydroponics the soils are desiccated and low in organic matter; and the setting up of large hydroponic systems might be reasonably comparable in costs with irrigation, natural humification, and other uphill methods of restoring fertility.

In England

Turning from Dr Gericke's pioneering work in California to British efforts, we find considerably different experiences. The tank-culture method has been a failure in our climate. Prof. Stoughton of Reading University, a leading investigator of this problem, attributes this to our low light intensity and to a difficulty in securing sufficient aeration of the roots. It does not seem clear to the writer why this latter factor should so markedly depend upon climate; however, it is reported that even when forced

methods for aeration have been employed the results have not been satisfactory.

As a result British attention has been directed to the sand culture method; that is, to replacing the soil with an inert medium such as sand, cinders, or even part-peat mixtures, and supplying the nutrients by periodically percolating a solution through the bed. The chemical nutrients have even been added in dry form to the beds and then watered in. A sub-irrigation method has also been developed; here the nutrient solution is pumped up into the bed, then allowed to flow back by gravity into a supply tank for further use at a subsequent pumping. In all these methods the bottleneck of poor aeration is overcome. The sub-irrigation method, though more expensive to set up, possesses two obvious advantages—it has a wide range of controllable flexibility, and there is little loss of unused nutrients in drainage.

Satisfactory plant growth of many kinds has been achieved by these British methods; indeed, such methods have also been successfully used in America by Gericke and other workers. But there still remains the economic necessity to obtain a high rate of cropping by close packing, and inevitably it seems doubtful whether our quota of sunshine is sufficient for real success. Stoughton has reported the interesting case of gerberas; these are flowers which are difficult to grow successfully in soil, but for two years gerberas were successfully cultivated by sand culture though the results obtained in the third year showed some deterioration.

Nutritive value of crops raised by soilless cultivation

A not unnatural query is frequently raised about the nutritive value of crops produced without soil. Here analyses for carbohydrate, protein, minerals, and vitamin C have shown no differences between soil and soilless produce. Gericke has recorded nutritive superiority for hydroponic-raised tomatoes so far as mineral values are concerned, as in shown in the table below :

	Potash	Phosphate	Magnesia	Sulphate	Lime
Soil-raised	·99	·21	·05	·06	·20
Soilless	1·63	·33	·10	·11	·28

The main point would, however, seem to be that the elimination of the soil does not cause nutritive deterioration; at any rate, so far the recognized laboratory tests for nutritive values indicate.

Advantages of liquid fertilizers

It is not entirely irrelevant to mention a fairly new development in fertilizer practice, the distribution of liquid-type fertilizers. Strong solutions of nutrient chemicals are being marketed for dilution and application much in the same manner as the old-fashioned liquid manures of gardeners. Many commercial market growers have adopted this method of fertilizer addition with success especially in greenhouse cultivation. In terms of nutrient cost per unit, these liquid bases for manures are more costly than solid fertilizers since even with strong solutions a large accompanying amount of water has to be packed and transported; but despite this, the results obtained by practical growers have led to an expanding demand. When powerful soluble fertilizers such as ammonium phosphate, triple superphosphate, potassium nitrate and phosphate, and urea are liberally available, it would seem more economic for both manufacturer and consumer to develop the use of solid bases for liquid fertilizers; the grower could then add all the water required according to a simple instruction of so many gallons to so many pounds of the concentrated mixture. Both here and in America it has been frequently reported that fertilizer applications in dissolved form are more efficient, quite small amounts of nutrients yielding maximum crops. The practice would seem best suited to (a) greenhouse work where the heavy plant demand for water so often vitiate solid fertilizer results, (b) as top dressings for summer crops in dry weather, and (c) where the fertilizer user is inexpert and tends to overuse solid fertilizers. Indeed, the success of liquid fertilizers may well have been considerably influenced by this last factor, for in many otherwise efficient market gardens and nurseries there is a great deal of fertilizer misuse. This would explain why some research stations tests have shown only small degrees of superiority for liquid fertilizers applications, for in such comparisons the solid fertilizers will undoubtedly have been expertly chosen and applied.

To sum up, it seems that much of the popular enthusiasm for hydroponics is exaggerated. As a hobby for the gadget-minded, or as a means of producing what might be called luxury

vegetables or flowers, there may be some future for the various methods in this country, particularly for sub-irrigation sand or clinker culture. Agriculture is certainly not threatened. But, beyond this negative judgment, there are the mightier prospects of hydroponic cultivation in those parts of the world where the sunlight and heat are intense and where, for that very reason, the soil is infertile. Largescale development of this kind might be undertaken if it was found that the general malnutrition of peoples who live in or near these regions cannot be remedied by adequate imports of food from the world's fertile regions. Hydroponics may remain little more than a curiosity; or it may become a major scientific contribution to the world problem of nutrition, a method of harnessing the sun's energy in areas it is at present entirely wasted.

Some experiments in soilless cultivation

A remarkable wartime venture into the field of soilless culture was made by the U.S. Army after they 'borrowed' Ascension Island from Britain and developed it as an air base. There is practically no soil on the island except on Green Mountain, where the few residents have vegetable gardens and pasture their sheep. The Air Quarter-master of the U.S. Army Air Forces chose Ascension for his first largescale test of soilless cultivation of salad crops, such as lettuce, tomatoes and cucumbers. The same method was tried on Iwojima, and other 'hydroponic' experiments have been made on Coconut Island and in British Guiana. On the strength of their success the U.S. Army is setting up acres of sub-irrigation basins in Japan. A well-illustrated account of 'Hydroponics Station No. 1' as the Ascension experiment was called can be found in the *National Geographic Magazine*, August, 1945.

The British Air Ministry is also interested in the possibilities of soilless cultivation.—Reproduced from *Discovery*, August, 1946.

RELIGION and labour rest on ploughshare.
It is not the colour of the cow but the breed that counts.
Good seed, good crop.
Good germ, good sprout.—*Agricultural aphorisms from the Deccan.*

Home Gleanings

AGRICULTURE IN THE DIRANG DZONG AREA

By J. P. MILLS

THIS note is based on observations and enquiries made during a brief visit in the latter half of May, 1945 and additional information supplied by Mr. Imdad Ali, I.P., Political Officer, Balipara Frontier Tract, who later visited villages I was unable to reach. It is by no means exhaustive and certain aspects which might be of great importance for agricultural experiments elsewhere in the hills of Assam call for more expert examination. The most important are the superlatively fine local cattle, the handy light plough, and the use of oak leaves as a fertilizer.

Topography

Dirang Dzong is the most important of a small group of 9 or 10 villages inhabited by people who call themselves Grangmarangpa, but are usually included under the general term of Monba. They claim a Tibetan origin and their culture is largely Tibetan. The floor of the valley they inhabit is about 5,500 ft. above sea-level, and the ranges to the north and south run up to 10,000 ft. and over. The climate is cool, but it is rarely that the winter snow line descends to the valley floor. No records have yet been made of the rainfall, but it is certainly far lighter than that of the plains. The main river, the Digien, and the side streams are very fast flowing, but excellent cantilever bridges give human beings and livestock easy access to all fields at all times of the year.

Types of fields

Little use is made of the flats along the river, as the soil is sandy and they are liable to occasional flood. Almost all the cultivation is on the gentler slopes near the base of the hills, where the soil is a rich loam. Almost all the fields are permanent, only the very poorest practising the system of shifting cultivation known in Assam as *Jhuming*, and there is a tendency to convert *Jhums* into permanent fields whenever possible. The slopes are roughly terraced to check erosion, each field descending to a steep bank faced with stone. The average field is on a moderate slope, but wherever possible level terraces are made and irrigated for rice. Double cropping of permanent fields is normal.

J. P. MILLS, Esq., I.C.S., is Adviser to the Governor of Assam for Tribal Areas and States.

The plough

Except on steep *Jhums* contour ploughing is universal. Two men are required to handle a plough. The plough is light and made entirely of wood. The wooden blade requires frequent renewal and is therefore detachable. A *dao* is the only tool required to make a new one, which is wedged into the base of the plough exactly after the manner of the blade of a carpenter's plane. Both the pole and yoke are long and light. One man guides the plough while the other both steers and assists the cattle from a position in the middle of the yoke alongside the pole.

The use of oak leaves

Double cropping is only made possible by the extensive use of the leaves of a large-leafed variety of oak (*boinang shing*) common also in the Khasi Hills and other parts of Assam. Large forests of this tree are carefully preserved, acorns being planted where trees are thin. The leaves are collected in the spring and stacked in large heaps on the edges of the fields. When the first rain has made them thoroughly sodden they are ready for use.

Main crops

Wheat and barley (*grinding* or *grunchun*) are sown in November. The land is ploughed, and the seed sown broadcast and ploughed in. The harvest is in late May and June. The mode

of reaping preferred is the most extraordinary I have ever heard of. The field is fired; the object of this is to burn off the awns, which make threshing difficult. The main stalk is only partially burnt, but the neck is burnt through and the ear falls to the ground, from which it is gathered. If the weather is bad the ears are usually picked by hand, sickles being apparently fairly uncommon. They then have to be spread out, dried, and singed to get rid of the awns. After harvest the half-burnt straw is pulled up by the roots and again burnt and ploughed in. The field is then ready for maize. Wheat and barley are never sown on *Jhums*.

A curious thing is that a small quantity of oats comes up with the wheat. It is not regarded as a food grain and is weeded out as far as possible. But it ripens before the wheat and enough rains fall to ensure it coming up again the next year. No one knows where the seed originally came from.

Maize (*pheritang*) is sown broadcast as soon as the field is ready, and ploughed in. When two or three leaves appear a thick layer of oak leaves is raked over it. In fields near villages I have seen farmyard manure also piled on the maize fields in neat, well-spaced heaps, exactly as in England. After the maize crop in the autumn the fields are again ploughed for wheat or barley. No use is made of maize stalks. There is no rotation of crops and a field is never left fallow.

On fields not used for wheat or barley maize is sown much earlier. On fields which I saw it was about 8 in. high and the oak leaves had been on the ground some time. This early crop is followed by ordinary buckwheat (*grinehing*) or a small variety known as *brasma*. On *Jhums* where the soil is good, maize is sown the first and second years. On poorer land *brasma* is sown the second year. The *Jhum* is then left fallow for 6 to 8 years.

Millet (*kongpu*) is the main *Jhum* crop where the soil is poor but is not very common in permanent fields. When permanent fields are put under millet it is sown in June and reaped in October, and is never followed by another crop, as it is thought to exhaust the soil. Apparently oak leaves are not used on millet fields.

On *Jhums* millet is sown the first year and *brasma* the second.

Rice seedlings are well up by the latter half of May. The land is ploughed and they are transplanted about the middle of June. Rice is greatly appreciated as a food, but it is only grown on irrigated land, and land suitable for irrigation is scarce. Probably some of the double-cropped wheat fields could be levelled and converted, but if they were they would only carry one crop instead of two.

Cattle

The cattle are far and away the finest I have ever seen in Assam. The animal is a hybrid of mithan (*bos frontalis*) and something else, and the best animals are typical mithan to look at, except that they never seem to have white 'stockings'. What the other strain is remains to be discovered. One informant told me it was *dzoz* (yak-cattle hybrid), but this I doubt. Breeding is all towards the mithan type, bulls which most closely resemble mithan being selected, and the rest castrated. Pure mithan bulls are also used, being obtained by a special trade described below.

The animals ordinarily browse on jungle, making it unnecessary to burn hill sides for grazing, with the consequent erosion. They will graze on patches of grass on slopes, though their necks are too short to get down to the grass on level ground unless it is very long. They are exceedingly tractable and both bulls and bullocks are used for ploughing. The milk is rich, and is all converted into butter and cheese. A cow is milked in the morning only, so that the calf gets its full share. A good animal will give 4 or 5 seers a day. The local cattle are only slaughtered for meat when they are very old.

Sheep are kept for wool only. When I was there all the flocks were away on the high pastures and I only saw a few rams which had been brought down for sale. They had exceptionally fine horns, and I suspect there is a strain of some species of wild sheep.

Cattle trade

An interesting trade in cattle plays such an important part in the system of breeding that it deserves a brief description. Bhutan borders on the Monba country to the west. Immediately to the east of the Monbas is the Lamai (Miji) tribe, and to the east of them are the Daflas. Bhutan has a surplus of ordinary cattle and wants bull mithan for breeding, the

Daflas have a surplus of mithan and want ordinary cattle for meat. There is therefore a constant movement of bull mithan from east to west, and of ordinary cattle from west to east. A Lamai buys a young bull mithan in the Dafla country for 2 or 3 head of ordinary cattle, which he has acquired by the reverse trade. He passes on the mithan to the Monbas for 5 or 6 head of cattle. For some reason breeding from pure mithan is believed to be difficult in the Dirang Dzong area. The bull would therefore be passed on to Bhutan for a good price in hybrids and ordinary cattle, some of the latter being killed for meat, and the others bartered with the Lamai for mithan bulls.

Yaks and their hybrids

Yaks are kept only on the very high grounds to the north. All but a very few of the bulls are castrated and used for transport, but all cow yaks are kept and many of them crossed with a type of cattle known as *glang*, the result being a *dzoz*. Mr. Imdad Ali, to whom I am indebted for all the information contained in this paragraph and much in the rest of the note, describes a *glang* as the smallest animal somewhat like a half-grown buffalo in appearance. A bull *glang* fetches a higher price than bull yak or mithan. Bull *dzoz* are never kept for breeding; they are invariably either killed for meat or castrated for use as transport animals. Cow *dzoz* are crossed with either *glang* or yak; but their calves are never allowed to live; they are killed at about a fortnight old to ensure the maximum yield of milk, which is said to be highest of any type of cattle known to these tribes. The above is only the merest sketch of a system of animal husbandry which would clearly repay closer study.

CLEAN SEED MEANS PROFIT TO FARMERS

ALL seeds require thorough cleaning and grading to remove weed seeds and offal, as well as light and shrunken kernels. Both experience and experiments have demonstrated the fact that the largest yield per acre may be expected from the use of large, sound, plump seed rather than from seed which has been poorly cleaned and graded.

In many places in Canada there are well-equipped seeds cleaning plants available to farmers, but it may so happen that these seed cleaning establishments may not be conveniently near some of the farmers whose only alternative is to clean their own seed. The farm-sized fanning mill, however, can do a good job if carefully operated. Improper cleaning of seed is due in most cases to lack of proper sieves or screens, or to improper adaptation of the mill. Some of the weed seeds are difficult to separate, but most of them can be removed if proper sieves are used and time is taken to determine the proper combination of size and slope of sieve, shake, air blast and rate at which the seed passes over the sieves.

The labour of cleaning and handling seed on the farm may be reduced considerably where the facilities permit the elevation of the seed from the cleaner to an overhead bin. From this bin, the seed may be spouted back to the fanning mill for a second cleaning. It is necessary to run seed through a farm fanning mill at least twice, and sometimes three times. If seed is to be cleaned a third time, it may be elevated to a second overhead bin which is within spouting distance of the fanning mill on the floor below.—*Dominion Department of Agriculture, Canada.*

Book Reviews

COLONIAL AGRICULTURAL PRODUCTION

By Sir Alan Pim (Published by the Oxford University Press, London, pp. 190, 10s.-6d.)

THIS recent notable publication has been compiled oy Sir Alan Pim, for 34 years a member of the Indian Civil Service, and issued under the auspices of the Royal Institute of International Affairs. The book is primarily concerned with describing and comparing the two principal systems of enterprise adopted for purposes of agricultural production in some Colonial Possessions. The two systems concerned are plantations financed mainly from abroad and small holder production by local peasants. The territories comprised in this survey are the Netherland Indies, Malay, Ceylon, Mauritius, Fiji, West Indies, Tropical African Dependencies, and British Central and East African Dependencies.

The main concern of the author is that of indicating both the merits and the defects in the prevailing systems of agricultural development in each of these territories in so far as they impinge on the problem of raising the standards of income and the standards of living of the colonial peoples. He approaches the problem with a broad perspective and with wide knowledge. He very rightly realizes that the problem at issue is inseparable from consideration of the prevailing land tenure systems, agricultural credit facilities, marketing, the ready supply of goods and services, the need not only of maintaining but of increasing fertility of the soil, and various other aspects. He arrives at no sweeping generalizations.

There is much in this book of interest and value to all concerned with agricultural planning in India, and particularly so the experience of the territories concerned in their attempts to solve their agrarian problems. Defective land tenure systems are a feature of most of these colonies. Measures adopted to improve the systems deserve close study. Land tenure problems loom large in practically all the countries of the world today. This is a feature inseparable from the world trend towards that form of socialization which demands a fairer division of wealth amongst the people. The public conscience has been aroused to the need to give the man-behind-the-plough a fairer share in the results of his labour and a greater incentive to production by improving the terms of tenure of the land he cultivates.

In India, while admitting that there are some glaring defects in the land tenure systems in some parts of the country, the removal of these defects will, in themselves, solve only in small part our agrarian troubles. There are other defects in rural economy of equal, if not greater, importance. Only by attacking them on all fronts simultaneously will the standard of living of the people be raised to their maximum potential. In general the pressure of population on the land, already acute in India, threatens to overwhelm rural economy. Economic disaster and widespread rural discontent cannot be averted unless the productivity of the land is increased so as to keep pace with the ever-increasing population. The technical measures whereby the productivity of the land can be substantially increased are fairly well-known, but the most effective means to attain that end are in large part matters of controversy and of a good deal of hazy thinking both by our administrators and by some of our professional economists.

The Kharegat Report on Agricultural Development in India, the Bengal Famine Enquiry Commission Report, the Gadgil Report on Agricultural Finance, the Krishnamachari Report on Agricultural Price Stabilization, the Vijayaraghavacharia Report on Agricultural Marketing and the Saraiya Report on Agricultural Cooperation—all deal with vital aspects of agricultural development in India. The implementation of the recommendations in these Reports will undoubtedly contribute materially towards improving the lot of agricultural workers, be they peasant proprietors, agricultural tenants or landless labourers. Yet there is cause for anxiety regarding the future rate of progress in increasing the productivity of the land whether through new irrigation projects, better conservation of rain water, manuring, improved agricultural practices or otherwise.

The book under review devotes a good deal

of space to those major indirect factors which contribute towards maintaining and improving the productivity of the land. Of special interest to India are the brief descriptions of some cooperative tripartite systems of farming adapted to local conditions. In these systems two of the parties are Government and the cultivator. The intermediary party provides the capital and also the goods and services needed in the villages. It may be a temporary Joint Stock Company as in the Sudan or a Utility Corporation financed mainly by Government as on the Niger in French Equatorial Africa.

The Gadgil Report on Agricultural Finance in India recommends the formation of Finance Corporations under Government aegis in those parts of India where the cooperative movement is unable to afford to villagers the desired credit facilities. There is undoubtedly considerable scope for improving agricultural credit facilities through the agency of such Finance Corporations based on the model of Credit Agricole in Egypt. But in those tracts where the need exists for expanding the proposed activities of the suggested Finance Corporations, this should be done so as to include land management on a cooperative basis.

The writer of this review has prepared for the Government of Sind an outline of a tripartite cooperative scheme for adoption as a pilot scheme on a block of 50,000 acres which will comprise part of 5 million acres to be commanded by the two new Barrage irrigation projects in Sind. He holds the view that such pilot schemes will afford Government the opportunity to tackle problems of land tenure, agricultural credit, and most aspects of village welfare on a sufficiently large scale to determine the nature and extent of those reforms which may prove to be feasible on a much larger scale.

The adoption of a cooperative system of development of those lands to be commanded by new irrigation projects in India and also large unirrigated tracts in the Terai deserves close examination. There are reasons for believing that the experience thereby gained would go far towards hastening the tempo of agricultural development in general.

In applying radical reforms to the villages there is danger of disrupting village society to such an extent as to make the remedy worse than the disease. The experience gained in operating the suggested cooperative pilot schemes will reveal the pitfalls and will be a guide in adopting practical and efficient measures to raise the efficiency of labour and the standards of living of the people by making maximum use of the physical resources.

It is well to be prepared for the day when pressure of population on the land will become so intense as to result in inevitable revolt unless measures are adopted to ensure greatly increased productivity of the land. Greater industrialization will be an aid in relieving this pressure but it will not solve the problem. In solving her agrarian problems there is little that India can learn from the Russian experiment based on maximum industrialization of the country, but she can learn a good deal from less revolutionary experiments in other countries.—R.T.

THE BARODA COOPERATIVE HORTICULTURAL SOCIETY'S ANNUAL

Issued by the Baroda Cooperative Horticultural Society Ltd., Baroda, 1946, pp. 26, Rs. 1-8.

It is the first report of the Baroda Cooperative Horticultural Society which has been established with the object of organizing efforts for the development of gardening, both ornamental and useful, in the city of Baroda and the State in general. Horticulture is a subject in which every citizen and every householder is interested for the decoration of his city or village and his homestead, and for the supply of the much-needed essential protective food consisting of fruits and vegetables. Organized efforts for stimulating interest and creating facilities for gardening is an urgent need of the country. It is encouraging to note that the provinces and States in India are taking due cognizance of this fact. The Agri-Horticultural Societies of Calcutta, Madras, Western India and Poona have made great contributions in the development of gardening. Recently the U.P. Fruit Development Board, The Punjab Cooperative Fruit Development Board, The Bihar Horticultural Society and Mysore Horticultural Society have also been doing very valuable work. We are glad to see that a similar institution has been started in Baroda

and it has got the requisite blessings and support of the authorities concerned, His Highness the Maharaja of Baroda being its Patron-in-chief and Lady Protima Mitter, the wife of the Dewan, as its first President. We wish the Society all success.

Naturally this first Annual contains the inaugural addresses and the other introductory accounts of the Society. It also gives some very useful notes and hints on certain aspects, e.g. lawn, rose-culture and common pests of the garden.—P.K.S.

APPLICATION OF STATISTICAL SCIENCE TO AGRICULTURAL RESEARCH

PROGRESS in the application of statistical science to agricultural research in India has been rapid during the last 20 years, and proposals to develop the Statistical Branch of the Indian Council of Agricultural Research into an Indian Institute of Agricultural and Animal Husbandry Statistics are under the consideration of the Government of India.

The Statistical Branch, which was formed in 1932, has three main functions, viz. advisory, training and research. The Branch assists agricultural officers in the provinces and Indian States in the planning of new experiments, helps them in the statistical analyses of their experimental results and undertakes the interpretation of statistical material which accumulates from year to year in all parts of the country and in all branches of agricultural research. Two post-graduate training courses in agricultural statistics—a Certificate course and a Diploma course—were instituted by the Statistical Branch in 1945. In addition, a short training course in Statistical Methods is also arranged by the Branch for officers deputed by the Central, Provincial and State Governments, Institutes of Agricultural and Animal Husbandry and the Universities.

Recently, the Statistical Branch perfected the random sampling method of crop yield statistics on a country-wide scale. This method has been found to give more reliable and uniform information.—*P.T.B.*

News and Views

AUSTRALIA FIGHTS LOCUST PLAGUE

HATCHING grounds of a locust plague—an immense expanse of country in south-eastern Australia already stirring with myriads of ravenous insects yet in the crawling stage—are the scene of a long-planned operation to save extensive areas in three States from being picked clean. In its incipient stages, the plague is being destroyed as a result of scientific planning by government research officers with the cooperation of farmers. Chemical warfare techniques developed in Australia by the Commonwealth Munitions Organization in wartime are proving deadly against one of the agriculturist's oldest and most destructive enemies.

Bombers with specially designed spraying apparatus roar low over the crops, gardens and pastures, blanketing them with the new British insecticide—Gammexane. On the ground farmers under the leadership of Department of Agriculture scientists are engaged in a ceaseless campaign of hand and power spraying with the same killer, and are baiting the pests with poisoned bran. In the battle against time to reduce the threat to manageable proportions before the hosts can take wing, the points are going to the attackers. Over 90 per cent of kills on all fronts is the result to date, though there are still large areas to be reached.

This is encouraging news for farmers who had been gloomily resigned to the disaster of a plague of even greater dimensions than the 1934-35 visitation, when swarms of grasshoppers (Australian plague locust) ate their way across the country, leaving a trail of desolation and ruin. Reports coming in from the border regions of Victoria, New South Wales and South Australia toward the end of last year, indicated that hopper egg beds were spread over an alarmingly large area and forehadowed a plague if seasonal conditions were favourable for hatching in the following spring.

Field officers of the Victorian Department of Agriculture, with lessons of the previous plague in mind, had been watching the danger zone each year for warning signs. They confirmed that the threat was a real one. Nothing could be done to destroy the egg beds, but a plan of action was prepared to cope with the hoppers at their first appearance. Poison mixing stations were established through the area to supply farmers and graziers with the ammunition for the ground attack—bran poisoned with sodium arsenite or gammexane, to be laid over the hatching beds; gammexane solution (15 per cent) diluted to one part in 100 for hand and power spraying on the ground.

The air attack was planned far ahead. Commonwealth and State experts collaborated with the Royal Australian Air Force in carrying out field tests to adapt the technique used by United States and Australian forces in air-spraying malarial Pacific beachheads. Standard spraying equipment, it was found, produced excessively heavy droplets, and was ineffective in securing adequate dispersal of the spray. Field tests resulted in developing of spraying equipment fitted with a number of orifices discharging the insecticide into the plane's slipstream. This produced controlled break-up of the liquid and more uniform droplet sizes.

Chemical defence section of the Munitions Supply Laboratories was called into the investigation of methods of dispersing insecticides, drawing on its experience in gas spraying experiments. Apparatus was designed for testing sprays of known droplet sizes, under standard conditions.

This consisted of an enclosed testing tower in which different conditions encountered in aerial spraying could be simulated. It enabled the researches to investigate the formation of droplets, their rate of fall, their effectiveness at different heights, and their range of distribution. By placing insects at the base of the tower, the speed of 'knock-down' as well as the time taken to kill, could also be determined.

Spraying solution found most effective to date is 4 per cent gammexane in Diesel oil, used at the rate of 3⅓rd gallons to the acre. The first mass movement of hoppers started early in October. 'Beaufreighters'—converted Beaufort bombers—went into action immediately, and the fight was on.—*Australian Agricultural Newsletter*, Release No. P/500.

FIG. 1. Beaufreighters roar low over a locust-ridden paddock in Victoria, spraying a solution of Gammexane and Diesel oil.

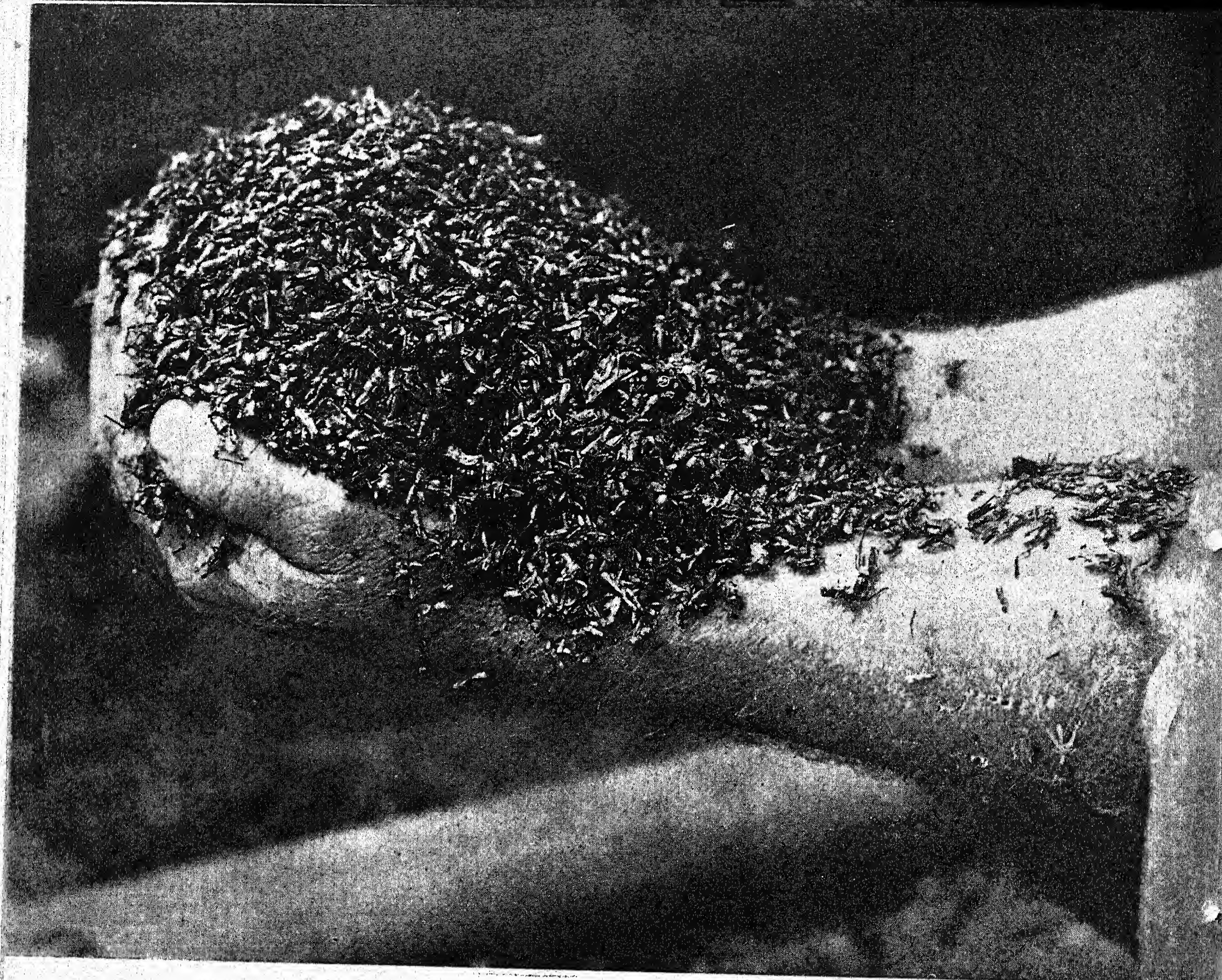


FIG. 2. Hosts of locusts were destroyed by spraying and poisoning over the hatching grounds.

PLATE 52

INDIAN FARMING

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INDIAN FARMING

MAY, 1947

Vol. VIII

No. 5

LIVESTOCK AND CLIMATE

OUR knowledge of the direct effects of climate upon the production and development of livestock is not great, but within recent years some scientific study of the subject has been done and a certain amount of information has been acquired. The indirect effect has been so much more marked and so much easier to understand that the direct effect is apt to be ignored or, at least, not studied with the thoroughness which it probably merits. The influence of climate upon plant life is immediately apparent, and plant life, as food, so profoundly influences the body which it nourishes that one is apt to accept it as the all-important factor in the relation of climate to the animal organism. Two further factors tend to obscure the direct influence of climate upon domestic animals. The first of these is that through the natural process of selection, animals found in any given locality have generally so conditioned themselves to the peculiar variations of the climate in which they live or, as we say, have acclimatized themselves, that the expression of unfavourable effects, if they exist at all, is minimized, and it is not until either foreign animals are introduced or the stock indigenous to one climate is transferred to another that the true significance of acclimatization becomes at all apparent. The other modifying factor is the purely artificial one given by man in affording the protection of buildings in which extremes of climate variations are modified to suit the circumstances.

In making a scientific study of the subject, if one is to arrive at factual knowledge, it is necessary to study each element of the climate separately and to so arrange things that, while the particular aspect under study can be manipulated in any desired direction, the other factors remain static and thus do not confuse the issue. The common factors involved are those of temperature, humidity, light and air currents, and because temperature is the most easily manipulated, we have learnt more about its effect upon the animal body than we have about the other factors.

It has been shown without doubt that the influence of temperature on milk secretion is profound. For instance, a difference of temperature from 40° to 95° F has been demonstrated to cause a drop of milk production from 29 to 17 lb. a day. European dairy cattle when imported into the tropics produce only slightly more than 50 per cent of their estimated capacity even when fed on adequate rations. On the other hand, low temperatures, provided the ration is adequate, appear to have little effect upon the quantity of milk produced, but there is some evidence to show that the amount of fat in the milk may be slightly increased. It is considered that for dairy animals a temperature of about 50° F is the optimum, and if that temperature can be maintained by a process irrespective of the outside atmospheric temperature, other non-climatic requirements being attended to, a uniformly satisfactory output of milk is likely to be assured. Improved dairy cows carrying a considerable amount of European blood, when maintained in air-conditioned barns at 70° C in Singapore, produced on an average 2½ gallons of milk, while the same class of animals kept under similar conditions but in an open barn exposed to the extremities of the tropical temperature produced somewhat less than one gallon.

In fattening cattle, the atmospheric temperature in which the animals are maintained will either encourage the increase in weight or hinder it. The conversion of food to fat or body weight is brought about by a process which cannot be accomplished without the production of heat. If the temperature is low, the surplus heat produced may be used in maintaining body temperature. In a warmer

atmosphere, it may not be possible to use it all in that way and the surplus must be disposed of by the ordinary body mechanism, by sweating, by respiration, and by other subsidiary means. In a yet warmer climate, where the disposal of surplus heat is difficult, the whole animal organism suffers, the appetite fails and the feeding process is slowed down or stopped. Thus, in a cold climate fattening animals must be kept warm so that food is not wasted on the maintenance of body temperature, while in hot countries they must be kept cool if production is to proceed at an economic rate.

Egg production too is influenced apparently by temperature, for it has been shown that fowls of the same breed produce larger eggs in the north than they do in the warm south and that the same birds produce larger eggs in the cold season than in the hot season.

The influence which climate bears upon fertility is indicated by the body mechanism whereby the testes are maintained at a temperature different to that of the other body organs. By reflex nervous control, the surface of the scrotum is expanded or contracted as greater heat conservation or dispersion is demanded by the atmospheric temperature, for high temperature directly affects the vitality of the reproductive cells. In fact, if, as happens in cryptorchids, the testes are permanently retained within the abdomen, the male, although able to serve, is invariably infertile. In rams it has been found advisable in hot climates to keep the region of the scrotum clipped.

It would appear too that to some extent high temperatures are detrimental to the fertility of the female. In the experiment carried out at Singapore already referred to, it was found that the cows maintained in air-conditioned barns were more easily put in calf, some 58 per cent of them conceiving within five months' time, while only about 25 per cent of those in the outside barn did so. The effect, however, on the male is even greater than that on the female. In a study of the breeding efficiency of aged bulls, it was found that those in the Southern States of the U.S.A. had an average fertility of 36 per cent while those in the cooler Western and Northern States had 48 per cent and the difference was considered to be due to the difference in atmospheric temperature.

It is the effect of temperature on the reproductive organs which is probably responsible for the phenomenon of the comparatively short breeding seasons in certain classes of animals, notably that of sheep. It was noticed, for instance, that the breeding season of our sheep in India is, for all practical purposes, confined to the cold autumn months; practically no breeding is done at all during the heat of the summer.

There is little factual knowledge concerning the effect of other climatic factors on the animal organism. However, it has been proved that the length of day, that is, the amount of light to which the body is exposed each twentyfour hours, affects the reproductive organs. This fact has been put to commercial use in the case of poultry where the supply of electricity is cheap. In northern climates, due to the shortness of the winter days, the want of sufficient sunlight has been made good with electric light installed in the hen house and the increase in egg production has more than compensated for the cost.

It is maintained by many that growth and development are directly affected by humidity but as yet we have no irrefutable evidence to support the supposition. It is conceivable that such may be the case, but it is far more probable that the undoubted fact that cattle in humid climates are small and undeveloped is due to the effect of agricultural practice rather than the direct effect of humidity upon the animal. Thus, in such districts rice is invariably grown and as the cattle have to live mostly upon the by-products of that crop, it is here, possibly, that the limiting factor lies. That, however, would give no reason for the degeneration, i.e. the loss of vigour and weight which is said to affect healthy animals imported.

Lt. Col. W. S. Read, P.V.S.

PLATE 52 (a)

LIEUT.-COLONEL W. S. READ, P.V.S.

AN APPRECIATION

LIEUT.-COLONEL William Stanley Read, P.V.S., Superintendent of the Government Livestock Farm, Hissar, Punjab, who proceeded on leave preparatory to retirement last year, came of an East-Anglian family of soldiers and farmers and was educated privately and at Cambridge University.

A keen Territorial soldier, he mobilized with his unit, The 25th (Cyclist) Battn., The London Regiment, at the outbreak of the Great War 1914-18, and after active service in Europe came to India in 1916. After further active service on the North-West Frontier he joined the Military Farms Department. On the conclusion of hostilities, the Punjab Government offered him an appointment in the Civil Veterinary Department, which he accepted.

He joined the Government Cattle (now Livestock) Farm, Hissar in November, 1919, and after a few years as Deputy Superintendent, was promoted to Assistant Superintendent and subsequently to Superintendent of the Institution. He served continuously at Hissar for over 20 years.

During his tenure at Hissar, Colonel Read initiated many improvements of a permanent nature, notably the drafting of the scheme which increased the output of pedigree bulls from 300 to 600 per annum, the rectangulation of 5,000 acres of irrigated land, the 'wat-bandi' scheme covering 40,000 acres to prevent soil erosion and improve grazing. He was greatly interested in fodder crop experimentation and in addition to introducing new crops, initiated and carried out the work which proved that sunflower (*Helianthus annuus*) could be grown throughout the year in Northern India, irrespective of season, as a fodder and oilseed crop.

In addition to being a keen practical crop and livestock farmer, Colonel Read was a skilled mechanic and held a certificate in diesel-engineering from one of the largest agricultural engineering works in England. He also designed the SA3 (Hissar) animal-drawn plough, especially for Indian conditions, now manufactured by Messrs Ransomes, Sims & Jefferies Ltd.

Colonel Read was for many years a member of various committees of the Imperial Council of Agricultural Research and a member of the Central Fodder and Grazing Committee, where his sound practical knowledge of fodder, grazing, wool, and erosion was of great value. He was also a member of the Board of Economic Inquiry, Punjab, and assisted in many valuable Economic Surveys. He was a regular contributor of thoughtful articles to such journals as *Agriculture & Livestock in India* and *Indian Farming*. He was the author of many useful Departmental Bulletins, and also of *A History and Guide to the Government Cattle Farm, Hissar*, a work which involved many years of patient labour in tracing the history of the Institution from 1805.

He will, perhaps, always be remembered for his study of the Angora goat and Mohair industry, and his conviction that a highly remunerative agro-industry could be established in Northern India by reviving breeding of the pure Angora goat in the northern foot-hills. In 1939, the Government of India sent him to South Africa on deputation to investigate, and report on the possibilities of starting a Mohair industry in India, and his observations there convinced him of the soundness of his theories. He purchased and brought back to India, entirely at his own expense, a highly pedigreed Angora goat buck (Mortimer). He subsequently lent this animal free of charge to the Punjab Government in order that the initial experimental work might be carried on in spite of the War. With funds provided jointly by the Imperial Council of Agricultural Research and the Punjab Government, experimental breeding by mating this buck with white Himalayan goats (the degenerated descendants of the original Angora goat) was commenced at Hissar, and the work so far carried out clearly indicates that the valuable textile fibre known as 'mohair' can be produced in Northern India.

Colonel Read's military history did not end with his appointment to the Civil Veterinary Department in 1919. Between the two wars,

he was a keen member of the Punjab Light Horse, and held a commission in the Army in India Reserve of Officers. He is also the holder of the Territorial Efficiency medal with bar. Early in 1940, as a Reserve Officer, he was recalled to the Indian Army for World War II, and was posted to the R.I.A.S.C. Within two years he was commanding a large Reserve Base Supply Depot with the rank of Lieut.-Colonel. In 1942, he was invited to transfer to the Military Farms Department, then rapidly expanding to meet the heavy demands of total War.—P.N.N.

WORLD LEVELS OF FOOD CONSUMPTION

THE cumulative effect of subnormal diet is commented upon in the third quarterly world food appraisal for 1946-47 by the Food appraisal for 1946-47 by the Food and Agriculture Organization of the United Nations (FAO). Nutrition and health, says the report, are little better than in 1945-46 ; in some countries worse. Many people have been living for five or six years on a subnormal diet and the cumulative effects are now becoming apparent—increasing incidence of hunger oedema, anaemia, and vitamin deficiency diseases.

The food appraisal contains a table showing estimated calory consumption levels by countries this year compared with pre-war levels.

Parts of India, parts of China, Malaya, parts of Manchuria, Roumania, Austria and Germany in 1946-47 have estimated consumption levels less than 80 per cent of pre-war diet.

Korea, the Philippines, parts of India, Java, parts of China, Algeria, Tunisia, Portugal, French Morocco, Greece, parts of Manchuria, Italy, Spain, Hungary, USSR, Bulgaria, Yugoslavia, Belgium, Uruguay, Cuba, Finland, Netherlands, United Kingdom, France, Switzerland and Norway have estimated 1946-47 consumption levels 80-95 per cent of their pre-war diet.

Mexico, Colombia, Iraq, Iran, Central America, Peru, Indo-China, Siam, Caribbean area, Egypt, Tropical Africa, Burma, South Africa, Syria and Lebanon, Chile, Brazil, Palestine, Turkey, Czechoslovakia, Paraguay, Sweden, Canada, Australia, Ireland, Denmark, United States of America, Argentine, and New Zealand have estimated 1946-47 consumption levels over 95 per cent of their pre-war diet.—*Dominion Department of Agriculture, Canada*, February 26, 1947.

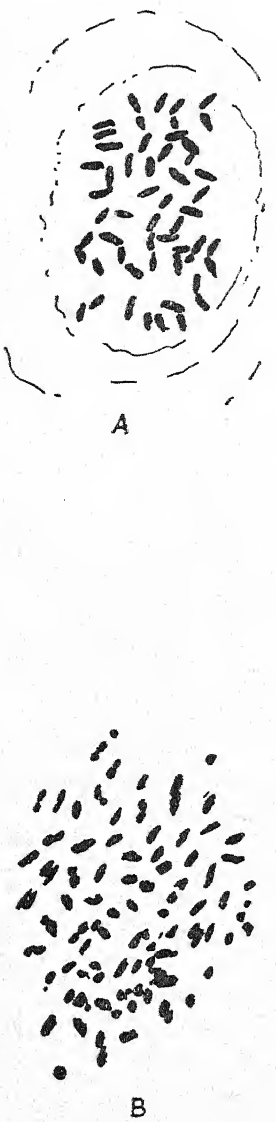

FIG. 1. Diagram illustrating polyploidy.
A—diploid, B—polyploid.

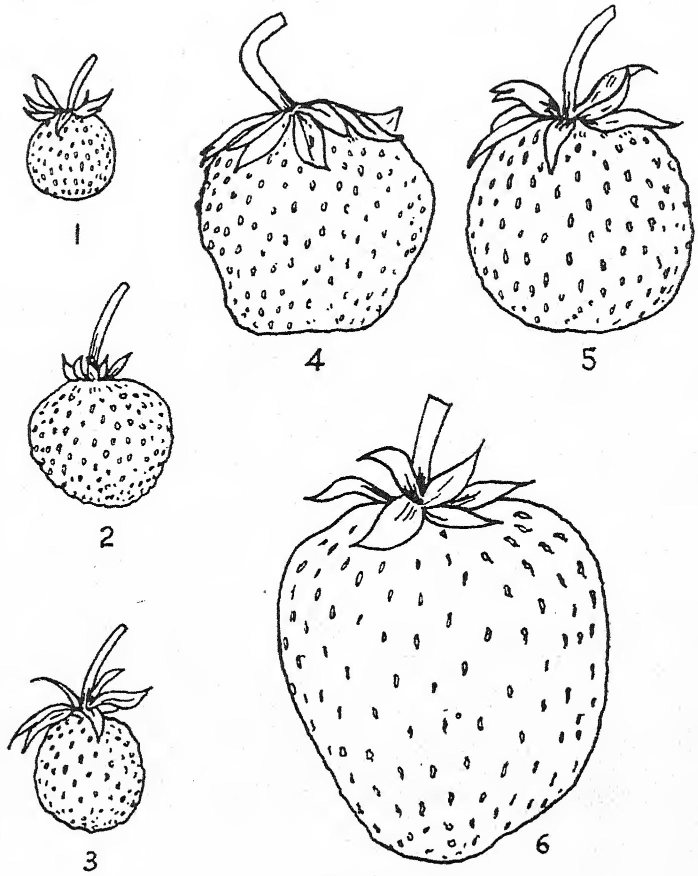

FIG. 2. Polyploidy in strawberry showing increase in fruit size following an increase in chromosome numbers.

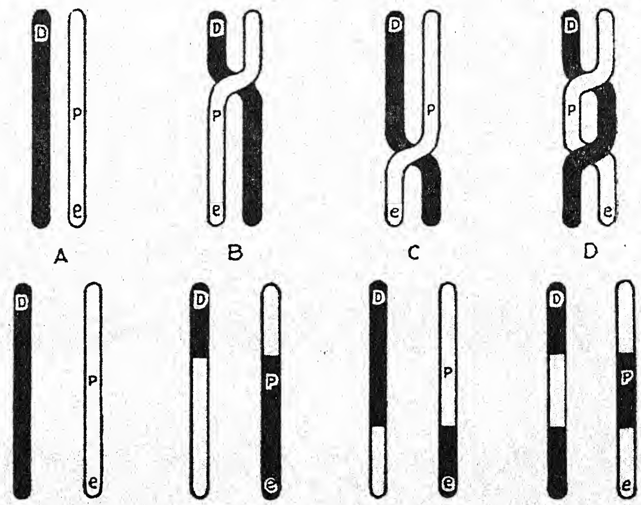

FIG. 3. The mechanism of crossing over.

NEW PLANTS FOR OLD

By M. S. RANDHAWA

PLANT breeders have made a great contribution to human prosperity by developing improved varieties of crops. The plant geneticist has made two ears of corn to grow in the place of one, and in some cases these two ears are also better in quality. It has been generally realized that one of the cheapest yet permanent means of improving plants or animals, is by breeding better types. The advantages of superior varieties of crops are that they are better in productivity, have more uniform and attractive market produce, and they have such agricultural attributes as earliness, higher yield, uniform maturity and greater resistance to disease. By placing improved varieties of sugarcane, cotton and wheat in the hands of the cultivator, the Indian Council of Agricultural Research has materially enhanced the wealth of the country. The improved sugarcanes alone have checked a drain of crores of rupees to foreign countries. The Pusa and Lyallpur wheats have appreciably increased the food supply of the country and improved varieties of cotton have provided higher yields.

How are new crops produced? Let us probe into the mysteries of plant breeding by examining our common garden annuals.

The gardening history of our familiar flowering annuals is very interesting and reveals how the explorers, naturalists, gardeners, florists and botanists of England, Germany, Holland, France, and the U.S.A. worked hard in discovering, acclimatizing and hybridizing various varieties of Dahlias, Asters, Sweet Peas, Verbenas, and Phloxes, which we in India collectively call English flowers. The common Phlox is a native of Texas, U.S.A., and was discovered by Drummond, an American botanist after whom it is called *Phlox Drummondi.* Sweet Pea was introduced in England from Italy in 1699 when Franciscus Cupani, an Italian monk sent some seeds to a Dr Uvedale of Enfield. The Garden Stock is found wild even now in the Isle of Wight, and has been grown in the gardens of Europe and England from early times.

However, it is the history of Asters and Dahlias which reads like a romance and also sheds light on the origin of new varieties. A single flowered Aster belonging to the species *Callistephus chinensia* (Family: Compositae) grows wild in the rocky hills of Northern China. It is an annual with a thin rosette of spreading branches, and the flowers are yellow in the centre and violet blue at sides with yellow hermaphrodite disc florets and violet blue female ray florets. Seeds were sent to Germany from China in 1728 A.D. where it yielded violet, red, and white varieties. By the end of eighteenth century, rose, lilac, blue, and purple colours had also appeared. A true yellow appeared recently. Subsequent variations have mainly concerned the form and size of flowers.

The common Dahlia was discovered by the German naturalist Von Humboldt in Mexico in 1789. In that year he sent two plants one with purple and the other with rose-coloured flowers to the court of the Spanish King at Madrid. From there it was imported into England by the Marchioness of Bute, the wife of the British Ambassador in 1804. In the same year Humboldt sent its seeds to Berlin and Paris. From 1804 a phenomenal change took place in the development of the Dahlia and numerous variations of form and colour arose at a rate without parallel in the history of domesticated plants. In 1806 the Berlin Botanical Garden reported 55 single and

M. S. RANDHAWA, M.Sc., F.N.I., I.C.S., at present Deputy Commissioner, Delhi, was Secretary to the Imperial Council of Agricultural Research. A reputed scientist, keenly interested in rural uplift, he is a prolific writer on such diverse topics as art, bioaesthetics, tree plantation, etc.

semi-double varieties. In 1808 practically all colours were obtained including new patterns as dark eyes and red-ringed discs. In 1830 a Swiss amateur reported 1500 varieties. Soon after Pompon and Cactus varieties appeared. Now we hear about Tree Dahlias with plants 16 ft. high producing panicles of flowers over two feet across. Thus ends the story of the two original species of Dahlias, the crimson *Dahlia coccinea* and the yellow *Dahlia variabilis*, though it has by no means closed, and the number of varieties will go on swelling through mutations and hybridization. In India Dahlia was introduced most probably in 1865 A.D.

Cells and chromosomes

As houses are made of bricks, similarly bodies whether of plants or animals, are made of certain units called cells. Each cell contains a denser central part called the nucleus and granular viscid living matter called cytoplasm, and this, in its turn, is surrounded by a cell-wall which maintains the cell's entity. While the various parts of the cell have particular functions to perform, the nucleus is the most important from the standpoint of heredity. The nucleus contains a fixed number of rod-like bodies called chromosomes, which are evident only at the time of cell division. The number of chromosomes is fixed for each species. Thus the number of chromosomes in man, potatoes, and common wheat is 48 and if you take a cell from any part of a European, a Chinese or a Negro you will find the same number. The cells of Adolf Hitler contained the same number of chromosomes as those of a Zulu from Africa. The number of chromosomes in onions is 16, in maize 20, and in rice 24.

Two types of cell-division take place in both plants and animals, one of which is called 'Ordinary Division' and the other 'Reduction Division'. Ordinary division takes place in cells of the body, and that is how growth takes place. In this the chromosomes split longitudinally in equal halves so that each daughter cell contains the same number of chromosomes as the parent cell. Reduction division takes place in reproductive cells and in this operation half the chromosomes go bodily in one gamete-mother-cell and the remaining half in the other. Thus eggs and sperm cells contain half the number of chromosomes of a body cell; the reproductive cells of man have 24 chromosomes, of rice 12, and of maize 10. When they mate together the normal number of the species is restored. This is a very sensible device, for it prevents the duplication of the number of chromosomes which will go on increasing in geometrical progression if there were no reduction division. However, this mechanism some times fails and we do get duplication or triplication of chromosomes resulting in giant varieties. This phenomenon is called polyploidy (Figs. 1 and 2).

Genes

All the characters of an individual are represented in its chromosomes in a condensed form, e.g. the colour of eyes, the shape of nose the colour of skin, the colour of hair in man, and the colour and form of flowers in plants. These chromosomes are the bearers of hereditary characters and represent a macrocosm within a microcosm. The chromosomes are thread-like, and they have specific regions which are concerned with the development of particular characters of a species. These regions are infinitely minute and are known as 'Genes'. The genes are the atoms of heredity. There may exist one or few or several genes for a character.

Linkage and crossing over

It has been found that certain characters are inherited together in a group, e.g. black body colour and vestigial wings in *Drosophila*. What is the meaning of this phenomenon of linkage (Fig. 3)? Morgan, an American biologist, explains that this is due to the presence of both the factors for black body colour and vestigial wings in the same chromosome, that is why they go together. However, these factors *do not always* go together, though they are linked in the same chromosome. We find a definite percentage of fruit flies with black body and normal wings and grey body and vestigial wings. What is the explanation of this crossing over of characters located in different chromosomes? Morgan explains that at a certain stage the chromosomes come in contact with each other and interchange definite sections from the point of contact. This crossing over takes place with greater frequency in the case of factors which are situated at the ends of chromosomes widely separated from each other, as compared with factors which are situated more close together. From the frequency of this crossing over,

Morgan and his co-workers Muller and Bridges, have been able to locate the different factors in *Drosophila*, and have mapped its chromosomes. This work of Morgan will ever remain a classic and is as important as Newton's discovery of gravitation.

What is the cause of variation and what is the mechanism of the changes which occur in the reproductive cells of flowering plants? How do we get double-flowered purple-mauve Asters, and double pink Dahlias from original single varieties with inelegant colours? What is the cause of the origin of pink, and blue flowers of Sweet Peas from ugly purple bicolour flowers of the ancestral plant? The cause and mechanism of all this change is the same which resulted in the evolution of man himself from hairy ape-like ancestors, and of horses from four-footed sheep-like ancestors. The cause of variation and the mechanism of its inheritance in the plants and animals is more or less the same, and before you learn how we get new plants from old, it is essential to understand certain primary facts of Biology.

Sex in plants

In plants also we find male and female sexes as in animals (Fig. 4). In some primitive plants like the ferns, *Cycas*, and the Chinese Maiden-hair Tree, *Ginkgo*, we find living motile sperms which are produced from the pollen and actively swim about in drops of water as in animals. In flowering plants this motility is lost and the male element is merely a mass of living matter or only a nucleus. The egg which becomes the embryo is securely enclosed in an ovule, which after fertilization becomes the seed. The ovule or a mass of ovules are securely enclosed in a folded leaf-like structure which is called the ovary and whose upper part, called the stigma, receives the pollen-grain by wind, or through the agency of bees and butterflies that come to suck honey from nectaries at the base of anthers and the ovary. The pollen-grains, which are produced in sac-like structures called anthers, germinate on the stigma and produce a long tubular structure which penetrates the stigma, and carries the male nucleus through the folds of the ovule to the egg-cell which it fertilizes. The fertilized egg becomes the embryo, the ovule becomes a seed, and the ovary and its lower part swells up and becomes juicy and fleshy, thus producing a fruit.

In some trees the sexes are entirely separate, there are male trees which produce male flowers only and there are female trees which produce female flowers only, as in the case of papaya and date palm. In castor-oil plant the male and female flowers are found in the same plant, the female flowers at the bottom of the stalk, and the male at the top. Similarly, in maize plant the male flowers are found at the top and the female flowers which develop into the cob are found below. In most plants however the male and female parts, the stamens and the pistil (the ovule containing ovary) are found in the same flower and such flowers are bisexual. In these bisexual flowers, the anthers and the ovule mature at the same time, the male cells of the same flower may fertilize the eggs in the ovules of the ovary, and such flowers are called self-fertilizing. Thus wheat and peas are self-fertilized. In most of the plants with hermaphrodite flowers the stamens and pistils mature at an interval and so self-fertilization is precluded, and cross-pollination takes place through the agency of wind or insects. Thus crops like maize, *bajra*, *sarson*, *toria* and vegetables such as cabbage and cauliflower are extensively cross-pollinated and are almost totally self-sterile.

Variations and new plants

We find variations in all plants and animals. In fact we find so many variations even in the same tree that it is difficult to find two exactly similar leaves. Variations are of two types: those which are inherited and those which are not inherited. The latter are of no importance and are the result of environmental factors. Thus you may manure a plant heavily and its leaves may become bigger but the colour, size and form of flowers will remain the same. On the other hand some sudden change may take place in its chromosomes, in their number or chemical or physical constitution, thus resulting in double flowers or colour change. Such a variation is inherited. Where a variation results spontaneously due to spontaneous gene change in the chromosomes it is called a 'Gene Mutation'. This is not due to direct effect of cultivation, nor is it due to hybridization. Thus a pink-flowered variety may give rise to a white-flowered form. Most of the new forms of flowering plants have resulted from gene mutations, and it is not unlikely that our own

species *Homo sapiens* originated in the same way by a chain of gene mutations occurring in the chromosomes of bipedal anthropoid apes.

Mutations

Mutations are the most important events in the organic world and occur for all kinds of characters and are of different degrees—strong and weak, good and bad. Benign mutations enable a species to maintain itself better and survive in the struggle for existence. From an agricultural standpoint, beneficial mutations would be those which would increase or improve productive capacity, disease-resistance, more attractive colouration of the petals, larger size of flowers, etc. of a plant. During the course of milleniums that the cultivated and wild plants have survived, countless mutations have occurred and are occurring. These have helped to increase the variations of all kinds in species of plants.

Some examples of agriculturally useful mutations in crop plants may be cited. In the Central Provinces a farmer found a new type of grain in his ordinary gram. It was more or less round like a pea (*mutar*) and had light orange coat colour. He multiplied the new type and found that it fetched better price in the market due to its attractive colour and *better* parching quality. Here is a case where a mutation proved agriculturally useful. Another farmer in the same province found a *green* grain of gram in the field of ordinary gram. The grains of this gram are green unlike those of ordinary gram; and the husk is also green. The green gram fetches higher price due to its unusual appearance and due to the fact that green colour makes people feel that they are using unripe grains. Both these variations arose as mutations. Recently a mutation affecting the growth habit in chilli was discovered by Dr Deshpande at the Indian Agricultural Research Institute (Fig. 5). The mutant plant has short branches and compact habit of growth. The fruits are borne in clusters. The plant is smaller than the ordinary plant, and, therefore, it should be possible to grow more plants per acre, increasing the yield considerably. Sometimes certain mutations occur which help to distinguish one improved variety from another. In an improved variety of tobacco, N.T. 5, which has pink flowers, a mutation arose which had white flowers. Since ordinary varieties of tobacco have pink or pinkish flowers the white flowered mutation would greatly help in distinguishing mixtures of ordinary tobacco plants.

Cause of mutation

What is the cause of mutations? Can we induce mutations? There must be numerous causes which induce mutations and their study is of very great importance. Once we master the causes, we will be able to induce mutations experimentally, and thus we will be able to control and direct the evolution of domesticated plants and animals, including that of our own species. Muller has found that X-rays increase the rate of mutations in *Drosophila*. The rate of mutations in *Antirrhinum* is considerably accelerated by the use of X-rays, chemicals and heat. Baur discovered that in *Antirrhinum* as many mutations were found in the year following X-ray treatment as had occurred in the whole of previous twelve years.

Polyploidy

Apart from gene mutations which we have already discussed above 'Polyploidy' is another fruitful source of new varieties and species of domesticated plants. Some times it happens that the chromosome complement of egg cells of plants does not get reduced. In such cases when fertilization occurs we get an embryo with three times the number of chromosomes of the parent plant. Such plants are called 'Triploids.' Triploids are common among plants which are vegetatively reproduced by means of bulbs, corms, and tubers or cuttings, grafting or budding. Most of the Japanese double cherries are triploids. These are highly sterile and produce only flowers and no fruit. As they do not exhaust their energy in the production of heavy crops of fruit, they flower profusely from year to year.

Some times reduction division fails both in the male and female apparatus of reproduction and the plant which results has double the number of chromosomes of the parent plant. Such plants are called 'Tetraploids'. If the same story is repeated again, the number of chromosomes is quadrupled and the plant resulting is called 'Octaploid'. There is a tetraploid race of *Primula sinensis* with 48 chromosomes, while the usual number for the species is 24 only. We also get 'Octaploids' among plants from Tetraploids. *Dahlia variabilis*, with its wide range of colour, is an octaploid which arose in Nature from hybridization

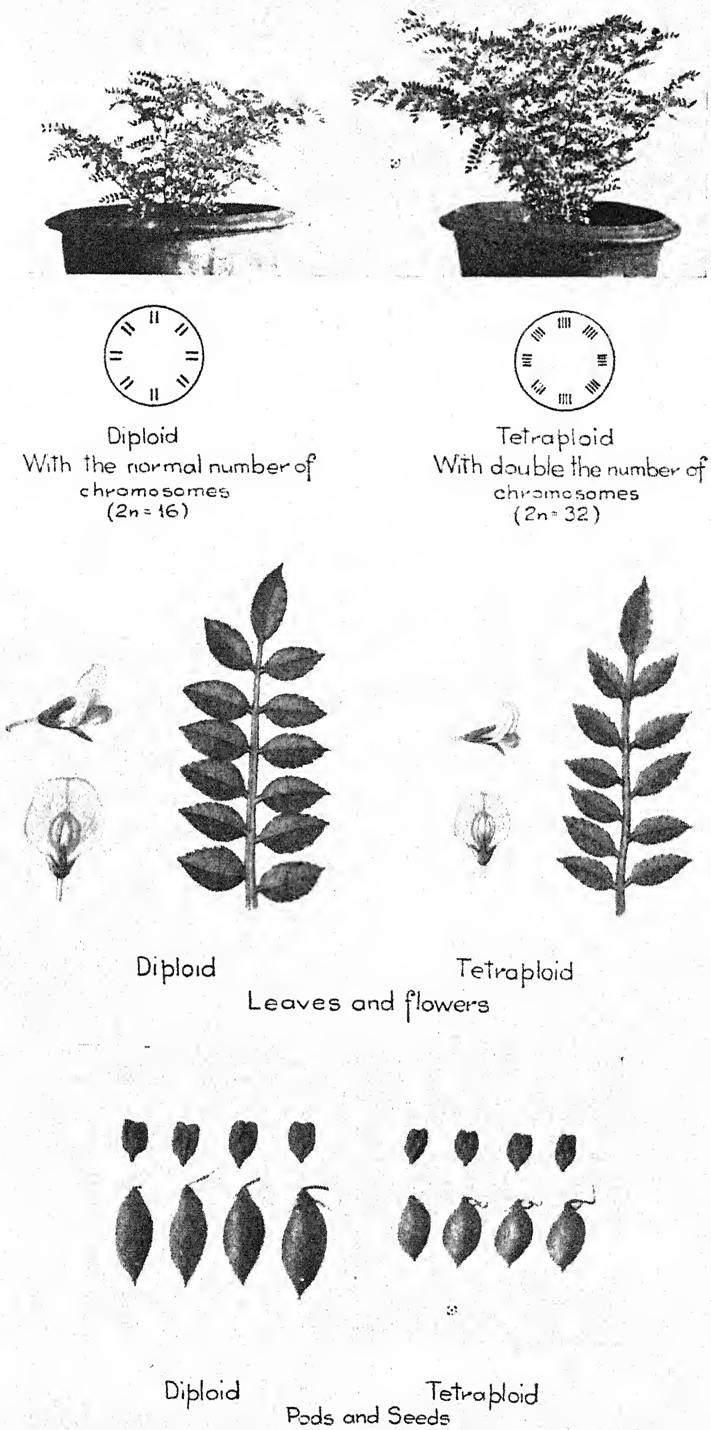

FIG. 7. Colchicine-induced polyploidy in gram (*Cicer arietinum*)

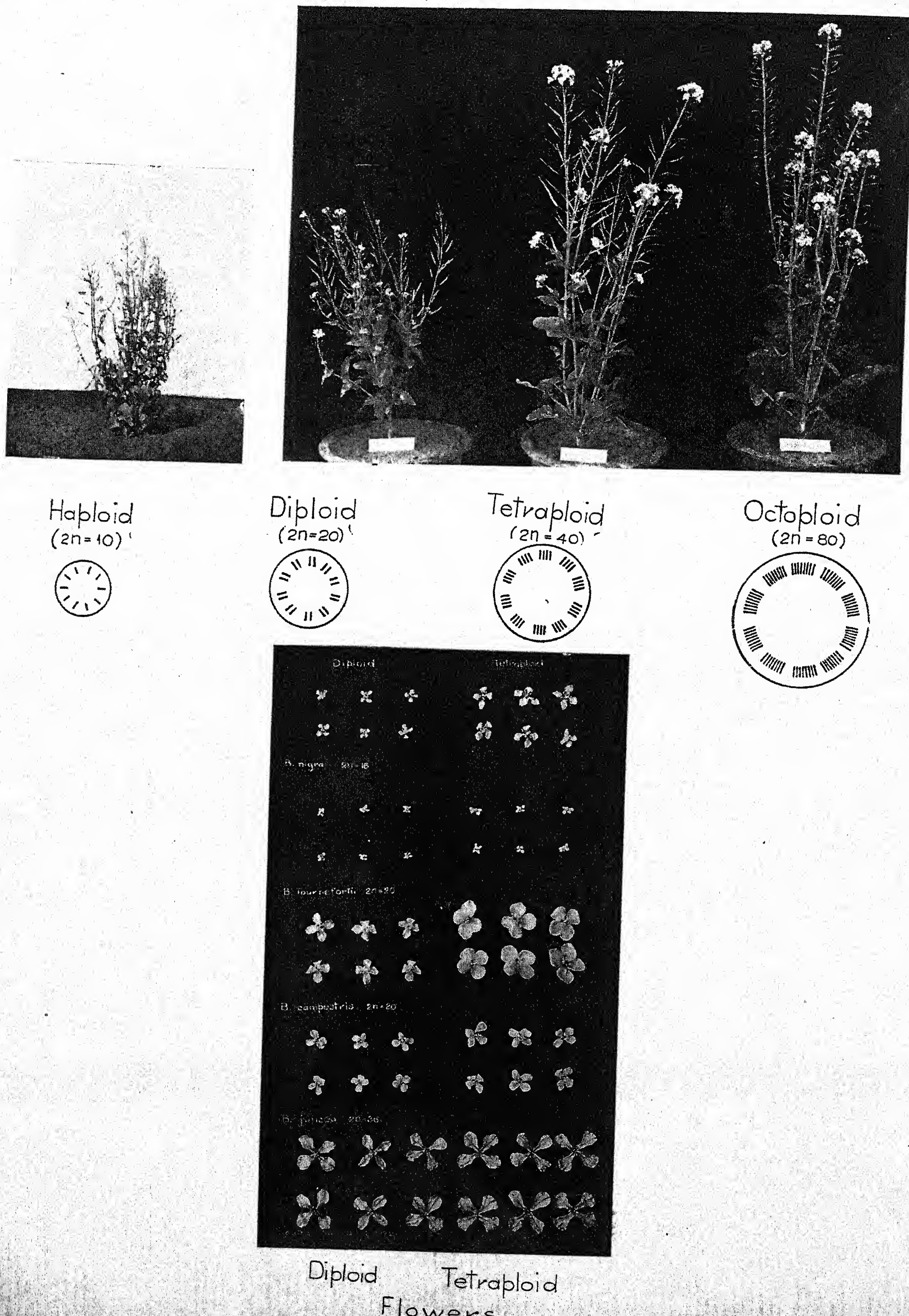

PLATE 59 FIG. 8. Colchicine-induced polyploidy in rape and mustard (*Brassica* sp.)

between two types of tetraploid species followed by chromosome duplication.

Increase in the number of chromosomes is usually followed by increase in the size of flowers, and in some cases of fruit also. Thus the tetraploid forms of *Primula sinensis*, *Campanula*, the triploid Tulips and Hyacinths, the tetraploid pears, and octaploid garden strawberries are much larger than the corresponding diploid forms (Fig. 2).

As polyploidy usually results in increase in size, it has great importance in raising new types of flowers and fruits. Can it be experimentally induced? Yes. Any chemical which inhibits spindle formation in reduction-cell-division will lead to doubling of chromosomes. Colchicine is a drug of this type (Fig. 6). Nebel and Tuttle have obtained tetraploids in tomato, marigold and *Dianthus* by the application of 0·4 per cent solution of colchicine in cotyledon stage. This resulted in the production of tetraploid shoots. This is a very important discovery and its application on a wider scale will result in the production of many new types of plants (Figs. 7, 8 and 9).

Hybridization

In the seclusion of an obscure monastery at Brunn in Austria, Gregor Mendel, an Austrian monk was quietly unravelling the mystery of hybridization and discovered his famous laws of heredity. After eight years' systematic work on the common garden pea, *Pisum sativum*, he published his findings in 1865, in an unknown local journal of science. This paper on which the whole foundation of the modern science of Genetics is laid remained unnoticed for years till 1900 when De Vries and other botanists rediscovered the laws of heredity on their own.

To illustrate Mendel's law of heredity let us take the case of the common plant Marvel of Peru (*Mirabilis jalapa*). By crossing a red with a white flower, we get a hybrid with pink flowers. In the second generation we get 25 per cent reds, 25 per cent whites, and 50 per cent pinks. While the reds and whites breed true and produce red and white flowers respectively in the third generation, the pinks segregate again in the Mendelian ratio given above. This is explained diagrammatically in Fig. 10.

The colour which prevails in the first generation is called 'Dominant'. Thus in this case red colour is 'Dominant', and white is 'Recessive'. Thus in man, curly hairs are dominant and straight hair recessive, and brown eyes are dominant and blue eyes recessive. On the other hand in the cattle hornless condition is dominant to horned, and black colour is dominant to blue in pigeons.

Hybridization merely results in mingling of chromosomes of two different species (Figs. 11, 12 and 13). It is merely the reshuffling of the same set of cards and not the introduction of new cards. New cards are only introduced by gene mutations and hybridization merely ensures a new combination. Even this has given rise to new races of cultivated plants, as in *Rhododendron*, *Iris*, *Vitis*, and *Rubus*. New characters are produced as a result of gene mutation and are presented in the form of new combinations by hybridization. It is thus that in Sweet Pea (*Lathyrus odoratus*) numerous varieties have arisen from a single wild species with purple bicoloured flowers. The same is the case with our other familiar garden plants.

When a plant breeder is assigned the task of improving a crop, he immediately exploits the *existing* variability in a crop plant. By undertaking selection of the *desirable* individuals, the required improvement is brought about. Sometimes it so happens that in the variety under improvement, not all the desirable characters are present, and therefore, with respect to the character lacking, no improvement is possible. In such cases the plant breeder resorts to hybridization of the variety under improvement, with another in which the required character is present, although the latter may not be suitable from other view points. We may enumerate a few instances.

Sugarcane: Most of the sugarcanes grown at present throughout India consist of synthetic varieties. These have been obtained by hybridization within different species or between well-known varieties. The original varieties of canes in India such as Paunda or North India, Pundia of Bombay and Poovan of South India were good cane varieties but had certain defects. Botanically these varieties are now known as *Saccharum Barberi* and because they have thicker stems than the wild cane *S. spontaneum*, they are generally known as thick canes. Thick canes are higher in sugar content, but are susceptible to many diseases, and because of their softer rind are also attacked by wild animals like pigs and jackals. On the other hand, the wild cane (the weed known

generally as *kans*) is very hardy and resistant to various diseases. The hybridization of sugarcane with the wild and other thick cane species, *S. officinarum*, has resulted in the succession of an extensive array of better and better sugarcane varieties developed by Sir T. S. Venkatraman at the Sugarcane Breeding Station, Coimbatore, Madras, during the last 30 years. At present the two sugarcane strains Co.419 and Co.421 bid fair to become universal varieties in India. We may illustrate the behaviour of Co.419 which has on an average yield from 55 to 60 tons per acre. The cost per ton of sugarcane produced by Co.419 comes to about Rs. 6 as compared to the cost of Rs. 8 to 9 per ton of such previous, famous varieties as 247B (J247) and P.O.J.2728. This cane adapts itself to varying conditions of soils and climate. Co.419 produced from a cross between P.O.J. 2827 and Co.290, two of the most famous varieties of the world, has been found to be more suitable for Southern India. The other variety, Co.412, has found favour in the Punjab and the United Provinces.

Cotton: In the southern part of Bombay a cotton breeder selected two strains of cotton and named them Dharwar-I and Dharwar-II. The former was superior in various agricultural characters over the local variety, but was susceptible to *Fusarium*, a disease which causes wilting of the plants in the fields. The other variety, D-II was, however, resistant to the disease to a very high degree under field conditions, although in other agricultural characters it was not so good as Dharwar-I. The cotton breeder crossed these two strains and obtained a synthetic type which combined the desirable characters of Dharwar-I and the field resistance of Dharwar-II. The new type has spread over almost the entire area of seven lacs of acres in the Bombay-Karnātak. This synthetic variety was named Jaywant, i.e. victorious.

Hybrid vigour

Shull and East discovered that inbreeding of maize separated this highly heterozygous plant into a number of pure lines, and these inbreds were invariably poor in vigour and yield as compared to the original open-pollinated variety from which they were derived. However when the inbreds were crossed among themselves vigorous F_1 hybrids were produced which far exceeded the yield of the original variety. The yield increases obtained in the U.S.A. are 40 per cent or more. Besides maize, agricultural utilization of hybrid vigour is possible in tomatoes and the egg-plant.

Conclusion

Thus through the efforts of geneticists and plant breeders who have made not only two ears grow in place of one, but also two bigger ears, we are moving towards the Age of Plenty. They are making use of gene mutations, polyploidy and hybridization and thus forcing the rate of evolution of domesticated plants and animals. Time will come when we will be able to control these processes, and will thus be able to control the destiny of our own species ultimately.

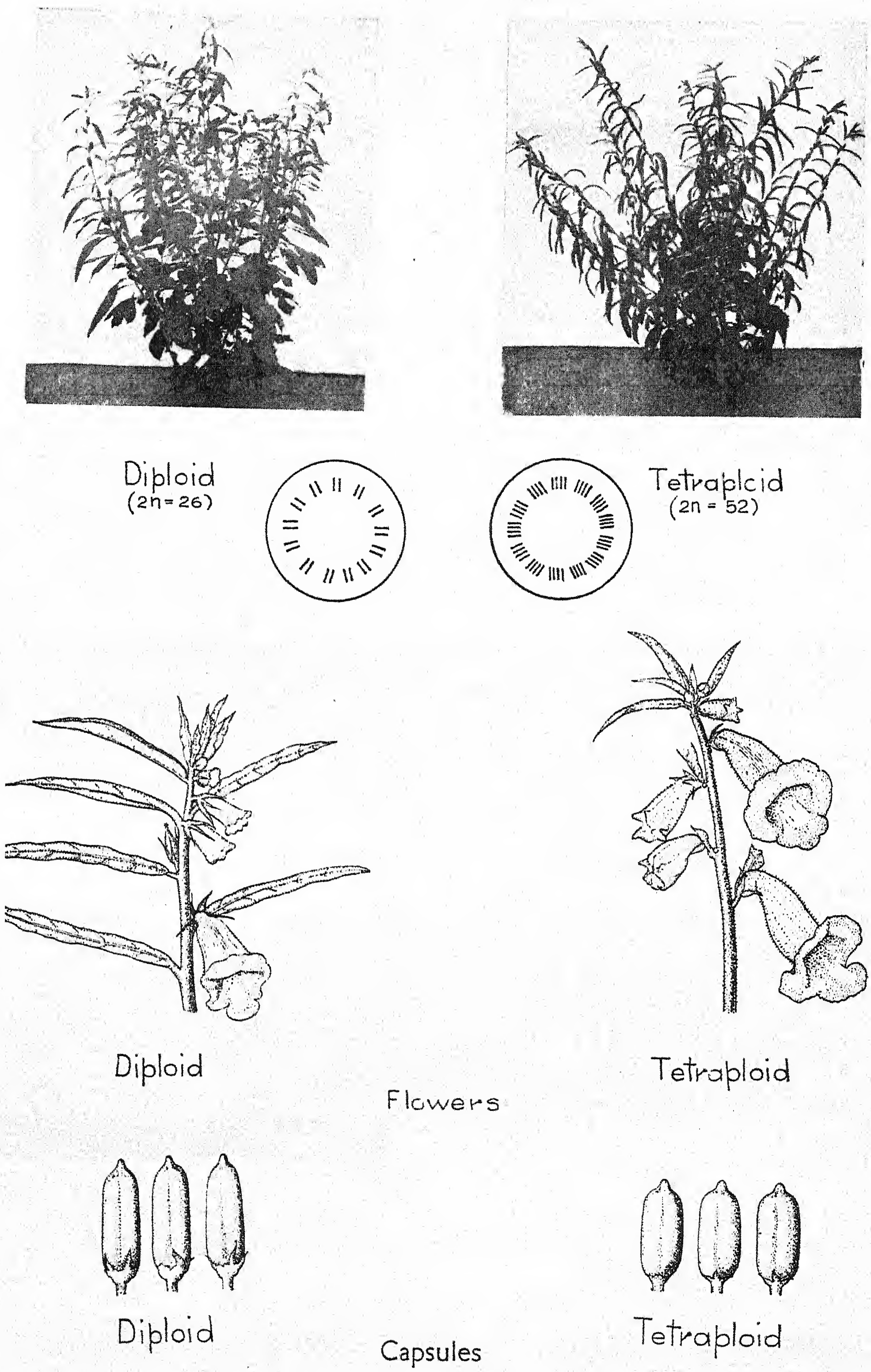

FIG. 9. Colchicine-induced polyploidy in sesame (*Sesamum orientale*)

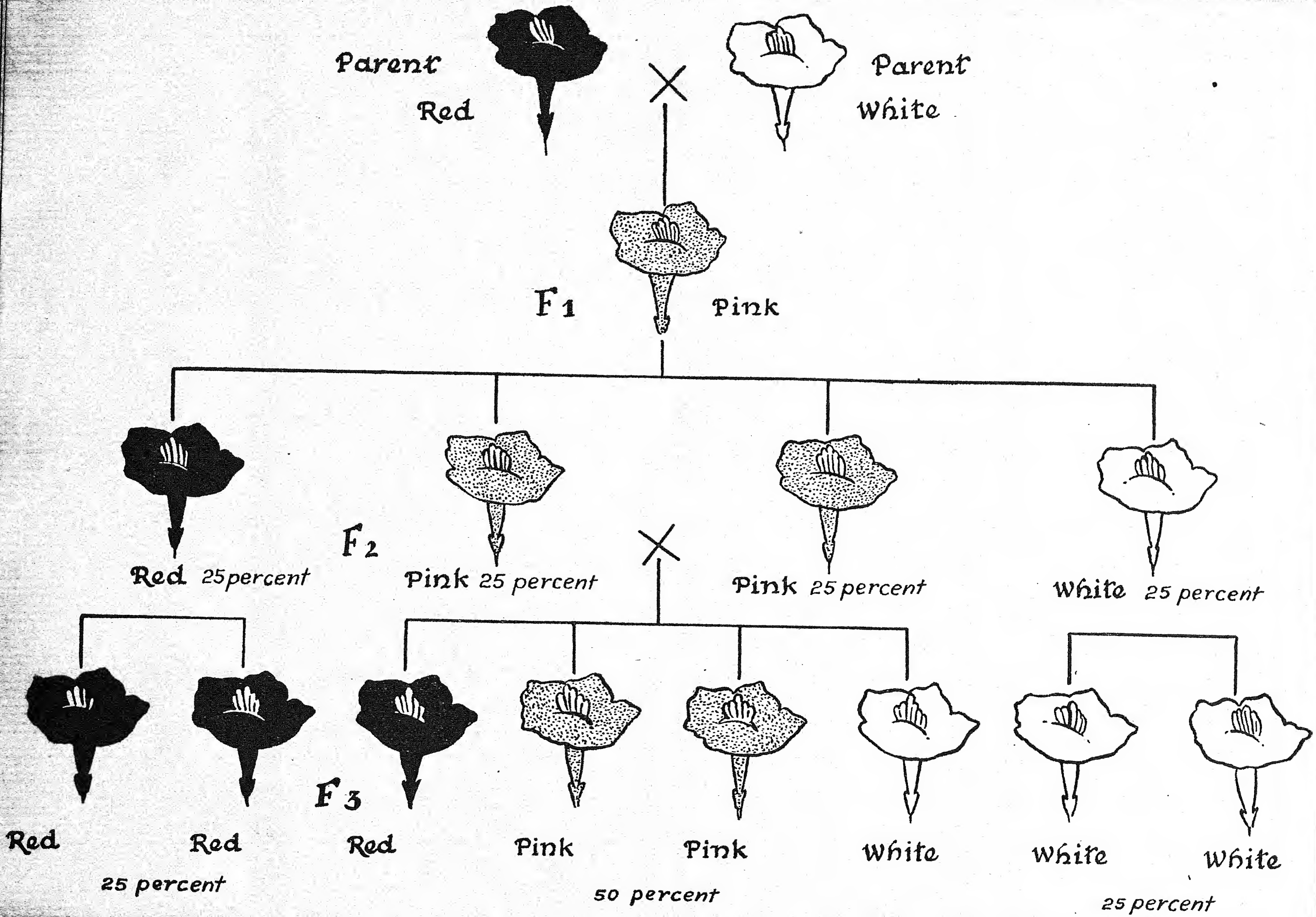

FIG. 10. Inheritance of flower colour in *Mirabilis jalapa.*

FIG. 11. Stamens are being removed from individual flowers before artificial pollination.

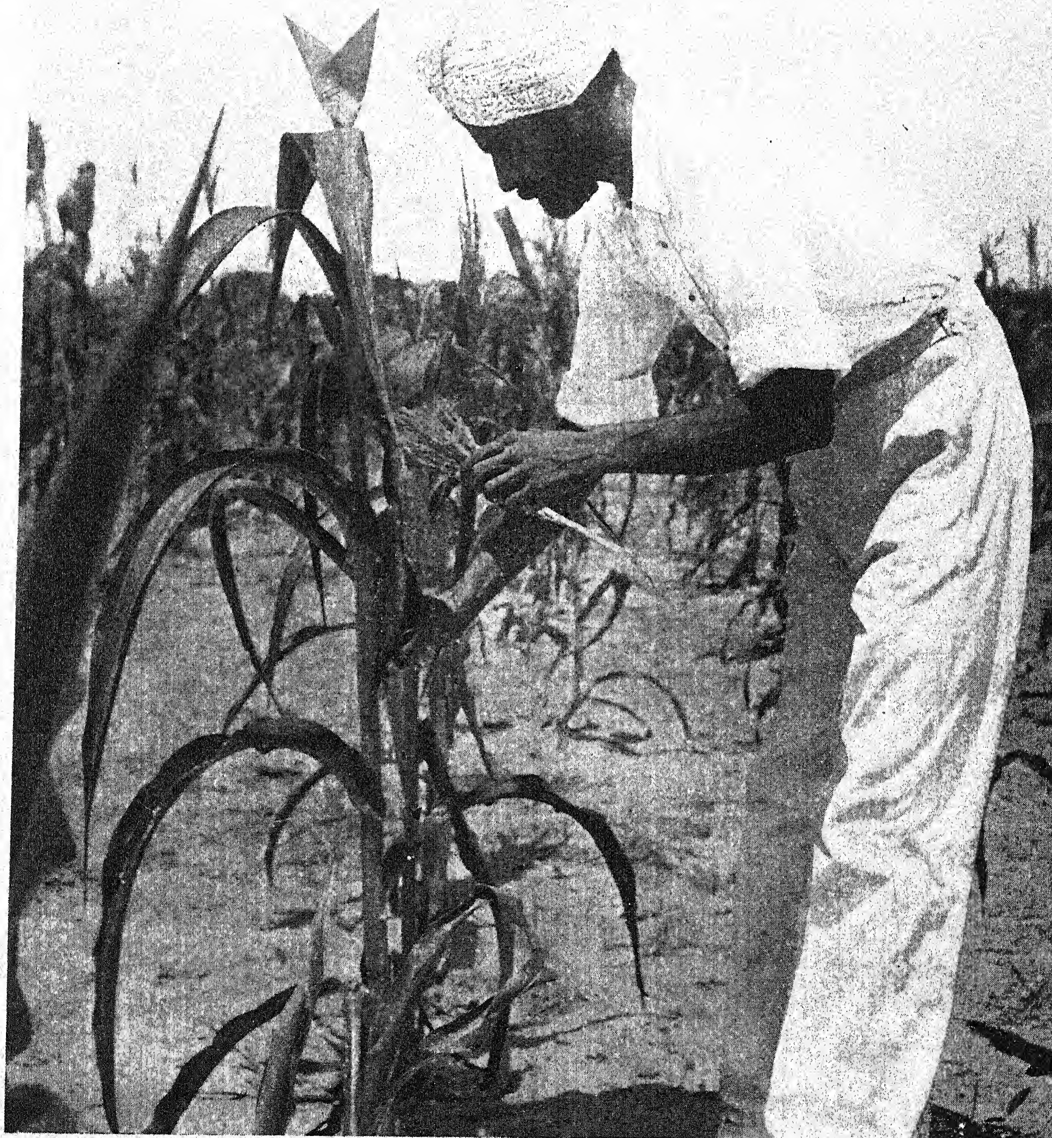

FIG. 12. The worker is dusting pollen on the 'silks' of maize.

FIG. 13. Bagging of floral portions after pollination to prevent contamination by undesirable pollens.

THE BUREAU OF PLANT PROTECTION AND QUARANTINES OF THE GOVERNMENT OF INDIA

By Y. RAMACHANDRA RAO

FROM the geological evidence recorded in the stratified rocks, it is apparent that the beginnings of animal and plant life on earth would date back to millions of years ago, in the course of which the modern forms of animals and plants were gradually evolved and became distributed in the various parts of the world. Their relative abundance in the different climatic regions was naturally determined by the action and reaction of various climatic and biological factors, leading ultimately to their reaching a state of static equilibrium. With the appearance, however, of Man on the scene, with his powers of using various natural forces to his own advantage, this balance was rudely upset. This was specially the case, when he began to grow various kinds of crops on a large scale. Thereby not only was the natural vegetation of the area displaced, but facilities were provided for the abnormal increase of various insects and fungi attacking these crops. Moreover, flourishing patches of green crops situated in the midst of comparatively barren stretches would naturally serve as an attraction for swarms of locusts and bands of birds and wild animals.

Again, with the progress of trade and commerce, a regular intercourse developed between distant countries, wherefrom there were opportunities for the purposeful importation of foreign plants and animals as well as of the unwitting introduction of pests and diseases from outside. In a good many cases, the new entrants, though known to be of little importance in their original homes, were found to exhibit an unusual degree of vitality or virulence in their new environments. As examples may be cited the rabbit in Australia, the mongoose in the West India, various plant plagues such as prickly-pear and lantana, and scale insects like the San Jose and Fluted Scales.

RAO BAHADUR Y. RAMACHANDRA RAO is Deputy Director, Bureau of Plant Protection and Quarantines, Department of Agriculture, New Delhi.

Such happenings have served to create serious problems all over the world, but these have been solved to a great extent by appropriate action based on scientific investigations. In India, a great advance has been made at the Central and Provincial Agricultural Research Institutes and Colleges in the study of the bionomics of several indigenous or imported insect pests and pathogenic organisms and in methods of controlling them. Some of the control measures have also been demonstrated on the fields of cultivators, as far as possible. In the absence, however, of the staff and equipment needed for undertaking control measures on a field scale, no large country-wide campaigns have, in general, been undertaken, and, as shown by the Famine Inquiry Commission of 1945, this will only be possible after the organization of a special plant protection service at the Centre as well as in every province of India. Such a potentiality has been well-exemplified by the remarkable success obtained in the control of locusts by the organizations set up by the Government of India and some local administrations during recent years.

With the rapid development of world-wide air services, distances have shrunk enormously, and the need for taking stringent precautionary measures has become greater than ever in regard to the prevention of ingress of foreign pests and diseases by the establishment of quarantine stations at all important points of entry into India by sea, air and land. It was with the object of filling some of these needs that a Bureau of Plant Protection and Quarantines has recently been established in the Department of Agriculture of the Government of India.

The Bureau has just begun to function, and in view of the various difficulties in procuring the required equipment and in the inherent delays in the recruitment of proper staff, it cannot be expected to be working at full strength immediately, but the following is an outline of the main functions it might ultimately be expected to fulfil.

Organization of field campaigns against pests and diseases

The necessity of arranging for an effective control of pests and diseases of crops would be realized when it is seen that, according to computations made in the United States of America and in Canada, on an average, about ten per cent of the yield is destroyed every year by insect agency alone, without taking fungus diseases into account. In India due to climatic conditions, insects and fungi reproduce more quickly and the losses in crop yields are, therefore, heavier. Unless the losses suffered in this way by the agriculturist are checked by effective measures of plant protection, the increases in yield obtained by various means such as better cultivation, better manuring and better seed, would be nullified to a considerable extent. It was obviously in view of this that the recent Famine Commission recommended that plant protection should be considered an important method of increasing food production. A few examples of the immense losses caused by pests and diseases in India may be given.

The *Helminthosporium* disease of paddy was, individually, one of a major causes of the serious shortage of the *aman* crop of 1942-43, which was itself an important factor in bringing about the Bengal Famine. The Red-rot of sugarcane frequently causes a serious deficit of sugar production, as, for instance, had happened in Bihar and United Provinces in 1938-39. Such losses can be averted, if there exists an organization capable of detecting the epidemic in the earlier years and promptly weeding out the diseased setts in time. Smuts and bunts of cereal grains cause a loss of about three million tons of grain per annum, which can be prevented to a considerable extent by the simple measure of using dressings of sulphur or other fungicides before sowing the seed. Several fruit pests, e.g. the Codling Moth, the Citrus White Fly and the Citrus Paylla, and the Hairy Caterpillar, are reducing the yields of fruit orchards by 50 to 80 per cent. This can be prevented by a timely application of sprays. The locust has, in the past, brought about famines, and the effective control of this menace achieved during the present cycle, may be taken as a fine example of the great potentialities of a well-organized Plant Protection Service. The control of pests and diseases is a provincial responsibility, and the Central Plant Protection Organization is designed to assist provinces and States in organizing control work against the more serious pests and diseases mentioned above as a part of the programme of 'grow more food' campaign of the Government of India.

While a good many of pests and diseases are only of local distribution and are thus of purely provincial importance, there are others like locusts which are capable of migrating from province to province. In such cases, an all-India agency is needed for keeping in touch with the migrations of swarms and organizing requisite control measures where necessary. So far as the desert locust is concerned, it has been possible to give warnings in time to provinces likely to be affected so as to enable them to be prepared against an invasion. In a similar way, it should also be possible as a result of appropriate studies, to give prior warnings about other migratory pests such as Army-worms, field-rats and migratory birds, and also about the likelihood of the appearance of air-borne plant diseases. In case such outbreaks flare up, effective action can only be taken if the efforts of all affected areas are coordinated by a Central Organization.

Prevention of entry into India of foreign pests and diseases of plants

As is well-known, some foreign insects have already established themselves in India having gained an entry along with imported plant material. For example, the San Jose Scale, the Codling Moth, the Fluted Scale (*Icerya purchasi*), and the Woolly Aphis of apple, have since their introduction caused an aggregate damage worth crores of rupees. It is, therefore, imperative that a strict system of quarantines should be enforced to prevent the entry of scores of other dangerous insect pests, such as the Potato Beetle, the Cotton Boll Weevil, the Mediterranean Fruit Fly, the Tobacco Ephestia, and the Wheat Stem Fly, and plant diseases like the Potato Wart disease, the Panama disease of bannana, the Fiji disease of sugarcane, etc. One of the main functions of the new Bureau would be the setting up of up-to-date quarantine stations at the main ports of entry by air and water and at the main frontier stations along the land routes. All plants and plant products likely to bring in any such infestation will be carefully examined, a record will be made of the pests and diseases intercepted and

the imported material will be fumigated thoroughly before being allowed entry, or perhaps destroyed, if considered to be of a too dangerous type.

Regulation of inter-provincial movements of plants

At present some of the imported pests, such as the San Jose and Fluted Scales, the Wheat Eurygaster Bug and the Codling Moth, are yet confined to particular areas or provinces, and it is essential that their spread into other parts of India should be prevented. The Bureau will arrange, with the cooperation of the affected provinces, for the regulation of inter-provincial movements of plants to safeguard the entry of such pests and diseases into new areas.

Introduction and utilization of useful parasites and predators

As is well-known, the biological control of various noxious insects and weeds of foreign origin was first effected in the United States of America, by the introduction of their specific natural enemies—insect parasites or predators or parasitic fungi. One of the classic instances of such successful work is the control of the Fluted Scale (*Icerya purchasi*) by the imported Ladybird (*Rodolia cardinalis*)—a method which is now being followed in India with similar efficacy under a coordinated scheme under the super-vision of the new Bureau.

In some cases, however, it has been found in America and elsewhere that the natural enemies introduced might, after exterminating a particular pest, turn their attention to insects of a useful nature, or to crops of economic value as in the case of insects imported for checking plant-plagues like the Prickly Pear and Lantana. As an instance in point may be cited the Lantana Scale (*Orthezia insignis*) which has since turned into a serious pest of diverse garden plants.

It is, thus, of extreme importance that the species desired to be employed for biological control should be thoroughly tested by a central agency like the Plant Protection Bureau, before it can be liberated in any part of India. Incidentally, the biological station where these tests will be made, would be able to breed various indigenous parasites and predators for purposes of liberation or for transportation to areas where they may be needed.

Collection and dissemination of information about pests and diseases of India

In view of the Bureau's responsibility in the matter of preventing the entry of foreign insects and diseases into India, there is the necessity of its being in possession of full information on the insects which are at present infesting crops and forest plantations in India, including their distribution and the nature and extent of their damage, and as far as possible actual specimens should be available for comparison with the species intercepted in the course of quarantine work. It is well-known that some of the species usually of minor status in some of the provinces may turn out to be serious pests under the conditions prevalent in other parts of India, and sometimes such insects have often been found to loom into disastrous dimensions under abnormal conditions in the same province. What applies to insects is generally applicable to various fungus diseases also. Similarly the Bureau has to gather information from other countries about pests and diseases which are common to them and India, as well as about such as are allied to Indian species, or are likely to get imported into India on plant material and trade cargos.

Though a good deal of information on various pests and diseases might have been gathered by the entomological and plant pathological sections in some of the provinces, in the course of observations made on them during a series of years, it is doubtful if the conditions under which they have assumed serious proportions in different parts of India at the same time or at different times have been recorded. In fact, some of the provinces have only a limited staff and their hands are too full with routine work. On the other hand, if the observations already made and the data recorded under the different conditions of various provinces or areas and in successive years are to serve any purpose, they should be properly collated. It is only then that general deductions of value can be made, from which conclusions of importance capable of enabling one to make forecasts of impending outbreaks may possibly emerge.

Control of destructive animals other than insects

Again, most of the work on record in regard to crop damage has reference to insects among the animal group, and to fungi in the vegetable

world. As pointed out by the Famine Inquiry Commission there are numerous other animals, causing damage to cultivation, such as birds, bats, porcupines, rats, monkeys, elephants, wild pigs, etc. among the vertebrates, and nematodes, mites, crabs and snails among the invertebrates, the control of which deserves serious study. Especially is this the case with birds and field rats. Similarly among plants, there is need of work on parasitic plants such as *Striga*, and of bacterial, virus and nematode diseases, all of which have been apparently neglected till quite recent years.

From this point of view, it would also be necessary to undertake work on these various groups under the different divisions of the Bureaux of Pests and Diseases as, for instance, under the heads of Agricultural Zoology, Agricultural Ornithology, etc. as the work of the Plant Protection Service gradually expands.

In conclusion, it may be stated that the Bureau will establish contacts with similar organizations in other parts of the world and will concern itself, in addition to its responsibilities for quarantine and pest control work, mostly with the development aspects of various plant protection problems of India. It will not only avoid all overlapping of work in progress in the provinces or at various research institutions, but will endeavour to assist them by supplying information in regard to various injurious species of India, either actually known to be harmful or possessing dangerous potentialities, as well as in regard to various important pests and diseases of other parts of the world.

NEW INSECTICIDE CALLED 666

BENZENE hexachloride (known as 666 and gammexane) has proved itself in two years of experiments carried out in Australia to be an outstanding insecticide. Less effective than D.D.T. for some pests, it is superior for others.

It is better than D.D.T. or sodium arsenite for the control of locusts and grasshoppers, and has the additional advantage over sodium arsenite of being less harmful to stock and to man. Other pests successfully tackled with 666 include sheep blowfly, stickfast flea, black beetle, fruit fly, sheep lice, sheep ked, fowl tick, pig lice and grass itch mite.

Experimental work is going on so that Australia may keep abreast, and possibly ahead, of developments in other parts of the world.—*Australian Agricultural Newsletter.*

COMMON MINERAL-DEFICIENCY DISEASES OF FARM ANIMALS

By J. M. LALL

THE growing realization during the last quinquennium of the necessity of minerals and vitamins in animal dietary has stimulated much interest and enthusiasm in the study of diseases resulting from a deficient supply of these essential dietary constituents. Though the actual mortality from these conditions is not high, when compared with that from acute infectious diseases, the economic loss brought about by such attendant features of deficiency as lowered productive capacity, reduced fertility and general unthriftness amongst livestock is enormous. Furthermore, a diet lacking in the essential constituents may so affect the constitution of animals that they readily become susceptible to a variety of infectious diseases.

Essential minerals

There are several mineral elements of which the body tissues are composed, but those which occur in comparatively larger amounts are calcium, phosphorus, magnesium, sodium, potassium, chlorine, sulphur and iron. Others, though occurring in minute amounts but considered as essential, are manganese, cobalt, copper and iodine. Amongst the macro-constituents, calcium, phosphorus and magnesium which enter into the composition of bone, and iron, which is a component of the colouring matter of blood, are by far the most important. As the requirement of these minerals for growth, reproduction and lactation is necessarily large, definite states of ill-health are likely to appear in cows and growing young stock, if the requisite quantities of these are not avaliable in the feed.

Causes of mineral deficiencies

(a) *Soil:* A large amount of essential minerals such as lime and phosphorus are exported out of India in the form of bones, but no compensatory return to the soil is made by the addition of chemical fertilizers. Soil-deficiencies are brought about by various other factors, the most important of them being, soil-erosion, excessive rain and injudicious system of agricultural practice involving lack of proper manuring. The deficiencies in the soil inevitably reflect in the fodders growing on it. Recent investigations on the mineral contents of pastures and fodders carried out at Coimbatore, Sabour, Dacca and other places have shown that fodders grown on a large tract of the country are deficient in lime and phosphorus.

(b) *Domestication:* Under wild conditions animals never suffered from deficiency diseases, but under domestication greater liabilities are imposed upon them to meet the demands for more milk yield, early maturity and frequent pregnancies. For all these lime and phosphorus come in greater demand and if the supply from feeds fails, the animals have to tap their own reserves to the extent that specific symptoms of diseases develop in them.

(c) *Ignorance of feeder:* If the aim is that the animals should avail of the maximum amount of minerals present in feeds, the various ingredients of the feed should be so compounded in a mixed diet that each is present in right proportion to the other. Thus for lime and phosphorus the right proportion or the optimum ratio in a feed should be 1·5 : 1. Any excess of one over the other interferes with the utilization. In practice this abject state is brought about by indiscriminate feeding where no judicious selection is made of feeds which would contain these substances in the required amount and proportion. In many cases, the lack in requisite supply of the minerals would depend upon the non-availability of approved feeds during certain parts of the year.

(d) *Lack of vitamin D:* This vitamin, in particular, is intimately concerned in making feed calcium available to the system. Lack of

J. M. LALL is on the staff of the Animal Nutrition Section, Indian Veterinary Research Institute, Izatnagar.

this would cause the animal to suffer from calcium deficiency although the calcium content of the feed might actually be adequate. Since sunshine acts indirectly as vitamin D, its essentiality in the stock dietary in India can ordinarily be overlooked.

Mineral-deficiency diseases

All animals possess a considerable reserve of minerals in their system which, if not supplemented through feed, is used up in the performance of various functions of the body. A dietary shortage of minerals, therefore, does not materialize at once into definite disease symptoms, until the reserve is exhausted.

The most important mineral-deficiency diseases encountered amongst stock are, (1) those in which bones show deformities, (2) those in which there is an increased sensitivity of the neuro-muscular part of the body, (3) goitre, a functional derangement of the thyroid gland, and (4) certain others in which the blood elements show definite alterations.

Bone deformities

In the unborn foetus, bones arise as a frame work of cartilage. With the growth of the foetus in the womb and after the birth of the young one, the frame work becomes hardened due to deposition of lime and phosphate. If in the ration of the dam, these minerals are not supplied in optimum amount or if for some reasons the availability of the minerals is affected, the developing bones of the young one fail to acquire hardness; and as it continues to grow and move about, the soft limb bones bend under the weight of the animal's body and become swollen at the joints. This condition is known as rickets.

Rickets is thus a disease of growing animals occurring chiefly in piglets, puppies, lambs and kids; foals and calves are rarely affected. Its incidence is greater in temperate countries. Larger number of cases occur in young stock of those breeds and species of animals in which the rate of growth is more rapid and necessitates accelerated demand for bone-forming elements. Besides the gross bone deformities as mentioned above, other symptoms observed in rickets are depraved appetite, convulsive attacks, clumsy movements and general weakness.

Lime and phosphate constitute about 75 per cent of the ash of bone. In spite of its apparently rigid structure bone is a mobile storage of these minerals. This storage results from day-to-day absorption of digested feeds containing these elements and is utilized simultaneously in the performance of bodily functions, for which the minerals are withdrawn from the store-house, i.e. the bones. The storage and the withdrawal are daily phenomena and if the diet of the animal is adequate in relation to these minerals, the withdrawal is actually balanced by the storage. The bone under adequate feeding, therefore, maintains its normal structure.

There are various factors operating under domestication which tend to upset this balance, with the result that the bones become abnormal. The modern dairy cow or any other domestic animal is bred for high rate of production which entails a considerable withdrawal of lime and phosphate from the bones. In a heavy milking cow, at the height of lactation, more lime and phosphate are drained out in milk than what are assimilated from the food. If the assimilation continues to be deficient, the bodily loss becomes inevitable. This is then reflected in the breakdown of the integrity of the bone causing grave pathological changes. The skeleton becomes lighter, more porous and fragile, the resultant porosities being filled in by a soft ground-work in preparation for subsequent mineral deposition in order to transform it into a proper bone structure. This deposition, however, does not materialize under the stress of increased production and deficient nutrition so that the bones remain soft, can easily be bent and cut with a knife. Under such pathological condition, movements on the part of the animal give rise to multiple deformities caused by muscular tractions on soft and weakened bones. This condition is known as osteomalacia.

Osteomalacia may, therefore, be looked upon as a disease of adult animals in which the bones are initially fully formed, but due to continued drain or depletion of bone-forming elements in the productive life of the animal, become depleted of reserve and consequently, weak and deformed. This condition occurs more commonly in cattle especially in pregnant and lactating cows kept under range system of grazing which is deficient in minerals. The condition may also be encountered under stall-feeding in certain commercial dairy herds,

where a saving in the cost of feeding is attempted by eliminating from the ration rather expensive phosphate-rich feeds. At the early stage, the phosphate-deficient condition manifests itself in the form of depraved appetite or *pica* when the animal shows craving for ingesting anything like earth, faeces, urine, bones, decaying carcases, etc. in order to satisfy its hunger for phosphorus. Later, the animal becomes lame and extremely emaciated, develops bony deformities and sustains fractures at any easy accident.

Of the two mineral elements in bones, phosphorus is more likely to be lacking in the feed of cattle. In other animals, particularly in horses, pigs and dogs, deficiency of lime in the ration usually proves to be the potent factor bringing about pathological changes in the bones. Lime-deficiency in animals is caused by feeding relatively large quantities of cereals and other concentrates which are rich in phosphates and very poor in lime. Under the condition of deficient supply from the diet, lime required for various physiological activities of the body is obtained by mobilizing it from the bone reserve and in consequence, as described for osteomalacia, the bones become porous and fragile. The cavities thus formed in the bone are filled in by scar tissue in the usual process of healing, which in certain part of skeleton, particularly in the skull, is deposited in an excessive amount, causing deformity of the skull bones. This condition is technically known as osteopeorsis or osteodystrophia fibrosa.

The disease occurs frequently amongst horses and mules, specially under such feeding regimen in which bran predominates and grasses or other coarse fodders are scarce. In the horse, the condition is also known as 'Bran disease', 'Miller's disease' and 'Big head'. Mild cases pass unnoticed, but in advanced state the animal becomes lame, quids half-chewed boluses due to pain in the jaw bones, becomes weak, debilitated and anaemic and shows the characteristic thickening of the jaw bones. Breathing becomes troublesome when the nose bones become thickened; this is also the pathological feature of the same condition in swine known as 'Snuffles'.

Neuro-muscular diseases

Certain minerals present in blood stream, particularly calcium, control the efficient working of the nerve endings of muscles. Many nervous disorders of animals occur when the normal concentration of these elements in the blood is lowered under their specific deficiency conditions. The commonest example is 'milk fever' which occurs in cows bred for high milk production. The disease occurs suddenly, just after calving and is characterized by coma and death unless promptly treated. It is caused by sudden stimulus of calving and lactation, which lower blood calcium level to almost one-third the normal. Any measure which can raise even temporarily the calcium level of blood helps in the recovery. This may be accomplished either by pumping air into the udder or by injecting a soluble calcium salt into a vein or under the skin.

Another element concerned in efficient functioning of the neuro-muscular apparatus is magnesium which must also be maintained at a constant level in the blood. In temperate countries, particularly in spring, when the cattle are let out for the first time to graze on young, lush, fast-growing pastures, the magnesium content of blood goes down as a result of which they suffer from nervous irritability, muscular tremors and convulsions. The symptom is popularly known as 'Grass tetany'.

Goitre

Goitre is a manifestation of iodine-deficiency. In certain regions of the world, including parts of India, there are areas where water is particularly deficient in iodine. In such areas a large number of human beings and animals suffer from this affection.

Thyroid gland is responsible for the production of the essential hormone thyroxine, in the make up of which iodine is a constituent. For continued secretion of thyroxine, therefore, requisite quantity of iodine must form a part of the normal diet of the animal. In the event of lack of this element, the gland makes an extra effort to keep the iodine content of the secretion normal, and in so doing, it becomes enlarged. This, however, hardly compensates for the physiological deficiency of iodine, and as a consequence, the animal suffers from general metabolic disturbance. Young and new-born animals are more prone to suffer and cases of hereditary goitre are known to occur in pigs, lambs and kids which are born with enlarged thyroids and bald skin. The condition can be

prevented by feeding traces of iodide salts in the ration of pregnant mothers.

Nutritional anaemia

The blood is composed of various elements of which the most important is its colouring matter which resides in the circulating particles known as red blood cells. An important constituent of the blood pigment is iron. In the formation and maturity of the pigment a trace of copper is considered necessary. These elements, iron and copper, must be present in the feed in certain proportion to ensure the normal formation of the pigment. The minimum relationship of these two elements may tentatively be placed at about 24 parts of iron to 1 of copper. Another element responsible for keeping the amount of this blood pigment within normal limits is cobalt, which performs this function by maintaining the normal number of red blood cells containing this pigment. Of these three elements, those likely to be deficient in feeds are copper and cobalt. In the event of deficiencies of these elements, the blood becomes poor in its pigment content, the red blood cells do not mature and their number also diminishes. This condition is known as 'primary anaemia' due to malnutrition. It is also variously known as 'bush sickness' in New Zealand, 'salt sickness' in Florida, 'nakuritis' in Kenya, 'coast disease' in Australia and 'pining' in Scotland. Investigations in these countries have yielded the information that in the areas where the disease is prevalent the fodders have been found deficient in either one or other of these elements. These blood elements are found lacking to a certain extent in milk also. The suckling calves, piglets and lambs, when fed on the dams' milk alone for a long period, develop more or less a similar affection referred to as 'milk anaemia'.

Remedial measures

Malnutrition being the specific cause for these diseases, the rational method of treatment would be to make up the particular deficiency either by correcting the feed or by supplementing the faulty diet with such ingredients in which it is lacking. The remedial measures against deficiency diseases should also aim at prevention. Grazing on deficient pastures should be avoided; where this is not possible, manuring of pastures with super-phosphates may be recommended. The diet of pregnant dams should include the essential minerals and vitamins in sufficient amount in order to meet the additional requirement.

As ruminants are more likely to suffer from phosphorus-deficiency, their feeds should include certain amount of concentrates such as, oil-cakes, bran, etc. Other animals, in which bone abnormalities result from calcium deficiency, should receive in their ration coarse fodders in requisite quantity and quality. Calcium phosphate or bone meal is recommended as a supplement for calcium and phosphorus in commercial dairy herds or Government breeding farms where production of pedigreed stock is undertaken on a large scale. In areas, where soil and forage are poor in 'trace minerals', the nutritional anaemias may be prevented by the addition of iron, copper and cobalt to common salt licks.

THE ERADICATION OF *KANS (SACCHARAM SPONTANEUM)*

By V. A. TAMHANE and R. V. TAMHANE

IN Central India vast areas of arable lands have gone out of cultivation due to the growth of the obnoxious weed locally known as *kans* (Lat. *Saccharam spontaneum*). This weed, if it once gets established, goes on spreading rapidly all over the field and then it becomes very difficult to eradicate it.

The senior author, on several occasions while touring in the Central Indian States in connection with his duties as the Agricultural Adviser to the States, had noticed this pernicious weed growing widely. Fields after fields infested with this weed would look hoary white and from a distance would give the appearance of a vast lake of water. This phenomenon is quite common from the month of September onwards to well-nigh January when the weed is in flowering stage. A number of attempts have been made to eradicate this pernicious weed by means of deep ploughing, etc. but no remedy so far tried has been found quite successful to eradicate it permanently.

A study of the literature on the life-history of the weed showed that the weed grows widely on the deep black cotton soil and its roots and underground stems penetrate very deep[1] into the soil. Obviously, ploughing the weed-infested field as deep as 12 in. to 14 in. with an iron plough or even a tractor will affect only the comparatively upper parts of the underground system of the weed, but as the remaining lower portion has reserve food material in them, they would throw out shoots which in the course of a year or two would again grow to a tall weed as before bearing inflorescence and matured seeds to be blown away by wind or carried to other places by rain, and propagating the pernicious species of weeds. Though the percentage of vital active seeds which give good germination is comparatively low (about 10 per cent), yet when we consider the vast number of seeds produced, the number of new plants produced by this process of seed dissemination would not be negligible. The rapid spread of the weed, however, is by the creeping underground stems which takes root at every node and throws out a vigorous new plant above the ground from almost every node. Thus it is that the rapid growth of the weed starts in bunches at different spots in the field ultimately filling the whole field with the weed and ruthlessly smothering the growth of any useful crop. Fields after fields have thus gone out of cultivation and caused miserable ruin to the owner of the field.

The junior author of the note, while on tour to Central India in connection with the soil survey work, suggested a remedy for the eradication of this pernicious weed based on theoretical considerations which were acceptable to the senior author who decided to give a thorough trial at the Institute of Plant Industry, Indore. The reasoning of the suggested remedy was as follows:

1. Since the depth at which the underground stem of the weed lived on the stored food material was often over 5 ft. it was impossible to eradicate the weed by the deep ploughing which can only affect the upper 9 in. to 12 in. of the soil layer.

2. Besides, heavy iron ploughs and tractors would hardly be available for the use of village cultivators.

3. The underground stems lived deep down in the soil on the reserve food material manufactured by the green leaves above the ground, the chlorophyll of which utilized the energy of the rays of the sun to manufacture food material, viz. starch which was reserved in the underground stem to be utilized when needed.

4. If, therefore, the green leaves are kept cut off by means of an ordinary iron blade harrow which every cultivator has and the

[1] *Kans* penetrating to a depth of 5 ft. has been noted at Institute of Plant Industry, Indore.

RAO BAHADUR V. A. TAMHANE was formerly Director of the Institute of Plant Industry, Indore.
R. V. TAMHANE, Ph.D., is Assistant Soil Survey Officer in the Indian Agricultural Research Institute, New Delhi.

leaves are not allowed to come above the ground and so are not capable of manufacturing further food material, no more food could be manufactured for storage in the underground stems. The underground stems would, in their turn, utilize the already stored food material and throw out more and more shoots. If these shoots are repeatedly cut off, a time would come when all the stored food material would be exhausted and the plant would die of starvation sooner or later. This death would take place throughout the length and breadth of the plant whether the plant is 5 to 10 ft. deep into the soil or has spread in a circle of any size at different spots in the field.

The following experiment was, therefore, tried at the Institute of Plant Industry, Indore, in 1943.

A field of about half an acre very badly infested with *kans* was selected. All the standing *kans* weeds were cut to the ground by hand scythe. The field was then divided into three equal portions (i) on one portion the iron blade harrow was worked twice every week for continuously four months.

(ii) On the second portion of the field the iron blade harrow was worked twice a week but continuously for eight months.

(iii) On the third portion of the field the iron blade harrow was worked twice a week but continuously for 12 months.

After the above treatment the three portions of the field were left untouched for full two years and wild grass, etc. was allowed to grow on each of the three portions and at the end of the two years, i.e. in 1945 it was found that nearly 40 per cent of the original *kans* persisted in the portion of the field which was under treatment of the iron blade harrow for only four months but not a single blade of *kans* was discernible in the experimental portions similarly treated for eight and twelve months. On all these three portions of the field annual wild grass of different kinds grew in abundance but the two portions, viz. those treated with the iron blade harrow for 8 and 12 months have been cleared off *kans* weeds. Trenches 3 ft. wide and 5 to 6 ft. deep have been dug into these two portions of the field to see the condition of the underground stems of *kans* deep down into the soil and it has been found that they have been all dead and decomposed.

Mr. C. P. Dutt, Farm Superintendent, Institute of Plant Industry, Indore, who has been associated with the experiment for a long time is trying it on more scientific lines of randomized block design to find out the economics of repeated harrowing and the results will be available in due course.

The authors would be grateful if those who have tried similar or different methods for the eradication of *kans* weed would publish their practical experience in *Indian Farming* for the benefit of other workers in the same field.

IMPROVEMENT OF TABLE-POULTRY IN NORTHERN INDIA

By N. G. SADIK

THE scheme for the improvement of the table-poultry in Northern India, was sponsored by the Punjab Government and the Imperial Council of Agricultural Research and was in operation at the Government Poultry Farm, Gurdaspur from November, 1937 to October, 1942. It aimed at (a) testing of the table-qualities of some important indigenous breeds (*Asil*, *Chittagong*, *improved Punjab* and *desi*) as judged by their live-weights and the rates of growth and (b) determination of the extent to which they could be improved by selective breeding and feeding and their fattening accelerated or improved by special rations. The scheme was very comprehensive and covered a very big field of research; a brief summary of the conclusions of practical importance is reproduced in the hope that it will be of interest to the poultry keepers.

Determination of qualities

The first year of the scheme was devoted to the determination of the qualities of each breed.

Rate of growth : The weight of every chick of the breeds selected was recorded at birth and thereafter, every week, till the age of 24 weeks was reached, i.e. marketable age. The *Asil*, the *Chittagong* and the *improved Punjab* put forth equally good growths but the *desi* were inferior. From the point of view of the rate of growth, therefore, there is very little to choose between the *Asil*, the *Chittagong* and the *improved Punjab*.

Production, fertility and hatchability of eggs : Every hen was trap-nested and the production of every individual, along with the weight of each egg laid, was recorded; the average production of each hen was also worked out. The *Asil* proved to be the poorest layers, with an average of 42·8 eggs per hen per annum, but there was no significant difference in the egg-laying capacities of the other three breeds; it may be taken at about 80 eggs per hen. The *improved Punjab* laid the heaviest eggs (average weight 1·92 ounces) and the next in the merit were the *Asil*, the *Chittagong* and the *desi* (average weights 1·76, 1·56 and 1·14 ounces, respectively). Fertility and hatchability of the eggs laid by each breed were also tested but the differences were insignificant. On the whole, therefore, it can be safely said that the *Chittagong*, the *improved Punjab* and the *desi* are equally good.

N. G. SADIK, B.A. (OXON.) is Deputy Director of Agriculture, Gurdaspur Circle, Punjab.

Practical results achieved

Subsequent years of the scheme were spent on the improvement of these breeds and the results of practical utility and interest are given below.

Breeding : The rates of growth of the first generation and those of two subsequent generations of each breed were compared. It was found that, in spite of selective breeding and very careful selection of the breeders, the stock of all the four breeds deteriorated in the third generation. The introduction of fresh blood, at least, every two years, is therefore desirable.

Rearing : The natural method of rearing chicks by mother-hens was compared with the artificial method. The results show that birds brought up by the latter method made better growths and were also healthier. The probable reason for this seems to lie in the fact that, possibly, due to the presence of light in the brooders, which is provided for warmth, the artificially-reared birds got more eating time and actually consume more food; at the same time they are brought up under disease-free and more hygienic conditions and thus escape infections, particularly from worms and lice.

Special fattening : The birds were kept in small coops, which were covered with gunny bags to provide semi-dark conditions to prevent movement and were given special feed of mash (60 parts wheat-meal, 40 parts yellow-maize-meal) mixed with whole-buffalo-milk, at the rate of 1 lb. of mash to 2 lb. of milk for the first three days and thereafter, increasing the

milk to 3 lb. This mixture was placed before the birds three times a day, for 15 minutes on each occasion. The fattening process continued for a fortnight on birds of 22 weeks of age. The birds fed in the manner mentioned above were compared with their prototypes under the ordinary semi-intensive conditions. The results definitely prove that the special fattening process was not superior to the ordinary system. The economics of special-feeding was also against it.

Rations: The rations comprising various feeds, of different protein-contents, were tried on the young and the adult stock. The standard-ration of the flock, as a whole, is given below:

(a) Grains. Wheat and yellow-maize, mixed in equal parts, were fed in the mornings and evenings, according to the appetite. In the early stage of the chicks, both grains were kibbled to suitable sizes and increased with the advancement in age and finally, when the birds were 12 weeks old, whole grains were fed. The average consumption of the grain-ration, up to 16 weeks of age, works out to about 1 ounce and thereafter, to about 2 ounces, per bird, per diem. The protein content of the grain-ration is 9·62 per cent.

(b) Mash.

	Parts by weight	
Wheat bran	30	Was always available in the hoppers and the birds could feed on it *ad libitum.* The average consumption of mash up to 16 weeks of age works to about one ounce and thereafter to about two ounces, per bird.
Wheat meal	40	
Yellow maize meal	20	
Fish meal	10	
Ground linseed	3	
Ground charcoal	2	
Protein content	15·82 per cent	

(c) Green food. In winter, chopped-berseem was given once daily at mid-day; during the summer season, sufficient forage was available from the green grass growing in the pens. The average consumption of berseem was 1 ounce and 2 ounces per bird per diem for the young and the adult stock respectively.

(d) Grit. River-shell, broken to pieces of suitable sizes, was kept in suitable containers and was always accessible to the birds.

(e) Water. Fresh, clean water was allowed *ad libitum.* Various other feeds and different protein contents of mash and grain ration were tried. The following recommendations can be made:

(i) The protein-contents of mash can be advantageously increased by about 2·13 per cent (from 15·82 to 17·95) by increasing fish-meal from 10 parts to 15 parts, for birds up to 12 weeks of age but thereafter, extra-protein is of no help and should be reduced to about 15·80 per cent.

(ii) If wheat and maize are difficult to get and/or are expensive, they can be reduced or eliminated from the grain-ration by paddy, *jowar* and *bajra,* so long as plenty of green food is available.

(iii) Protein from groundnut-cake, with 1 per cent common salt, can replace the animal-protein from fish meal up to 24 weeks of age; it is, however, pointed out that the effect of allowing protein-supplement of vegetable origin only beyond this age was not studied.

Conclusions

In view of the results obtained, the following conclusions can be drawn.

(a) The *Chittagong* and the *improved Punjab* can be safely recommended to those who wish to produce birds for the table but, on account of the fact that the *improved Punjab* are irregular in body conformation and also because their plumage is not fixed, should not be taken up. In other words, therefore, the *Chittagong* are the best birds for the table.

(b) There is no advantage in giving special fattening-food, provided that well-balanced rations are given from the very beginning.

(c) Chicks reared by the artificial method are superior to those brought up by the mother-hens. Artificial rearing is preferable; it is, also, more economical, as it does away with the necessity of keeping a large flock of hens merely for obtaining broodies.

(d) Groundnut-cake, in conjunction with 1 per cent common salt, is a good source of protein; it is, also, readily available in the villages at cheap price.

The following work, though not directly connected with the scheme, was also undertaken and as the results appear interesting, they are reproduced below.

(a) There is a very popular belief that in the Punjab, eggs cannot be hatched in the cold months of December, January and February

and further that the best hatching months are October, March and April. The results of monthly hatchings, from October to March, show that there is no truth in this and further that hatchability in October, probably due to poor condition of birds, subsequent to moulting, is poorer than that in other months.

(b) In the villages of the Punjab, it is generally said that there is no relation between the weight of the egg and the resulting chick. The veracity or otherwise of this belief was tested by actual experiments; the results obtained show that there is a very definite correlation between the weights of the egg and the resultant chick; bigger eggs produce bigger chicks.

POET Ghag addressing his wife says, 'there will be such a bumper crop of paddy that even dogs will not take it provided there is rain in *Rohini* and cloudy day in *Adra Nakshatra*.

Note: *Rohini Nakshatra* generally commences from 25 May and lasts for 10 to 13 days. *Adra Nakshatra* generally commences from 21 June and lasts for 7 to 14 days.

Westerly winds at the time of winnowing minimizes the chances of its being infested with weevils.

Easterly winds in February/March cause wheat rust.—*Agricultural Aphorisms from the United Provinces.*

THE EFFECTS OF WAR ON AGRICULTURISTS IN THE CANAL COLONIES

By LEKH RAJ DUA

THE war has ended but normal peace has not yet been restored. The period of stress and struggle, toil and turmoil, scarcity and control has upset the normal working of human activities and the consequent abnormalities have had great repercussions on the general economic conditions of the people. At the beginning of the war, the prices of agricultural commodities were abnormally low and hence the income of the agriculturist was far below the subsistence level. He was groaning under the burden of heavy debt. He was, as has been well-expressed, born in debt, lived in debt and died in debt and, what is worse still, left a legacy of debt for his heirs. So during the period of falling prices, the agriculturist was the greatest sufferer; complaints were heard from all quarters and it was suggested that prices of agricultural commodities should be raised and relief given in respect of debts and other obligations to the farmer.

Rise in prices

However with the outbreak of war, the price situation improved and there has been a great rise in the prices of agricultural commodities. The demand for agricultural goods in particular was very great in home as well as abroad. With the same yield, agriculturists were able to derive greater income per acre as a result of higher prices. There are strong grounds to believe that agriculturists have shared the general wave of financial prosperity. The rise in agricultural prices ranging roughly between 300 to 450 per cent is a proof positive of this. Certain figures of Lyallpur District are given below just to indicate the gradual rise in prices of agricultural goods and the net profit per acre which the producers of different commodities have gained.

TABLE I

Prices of wheat and cotton in the Lyallpur market

Crop	1939	1940	1941	1942	1943	1944	1945
Wheat	Rs. 2 to Rs. 3-2	Rs. 3-2 to Rs. 3-8	Rs. 3-8 to Rs. 4-6	Rs. 4-6 to Rs. 5	Rs. 5 to Rs. 11-10	Rs. 10-7 to Rs. 9-14	Rs. 8-9 to Rs. 9-14
Desi cotton	Rs. 4-12 to Rs. 8-14	Rs. 9 to Rs. 6-14	Rs. 5 to Rs. 4-6	Rs. 6-6 to Rs. 9.12	Rs. 9-12 to Rs. 16-15	Rs. 15-4 to Rs. 11-12	Rs. 10-15 to Rs. 17-4
American cotton	Rs. 6-8 to Rs. 11-6	Rs. 11-11 to Rs. 8-15	Rs. 8-7 to Rs. 8-6	Rs. 11-12 to Rs. 15	Rs. 16-13 to Rs. 23-9	Rs. 22-14 to Rs. 18-13	Rs. 20-10 to Rs. 22

From January to August 1939 prices of wheat ranged from Rs. 2 to Rs. 2-7-0 per maund and then they began to rise. The first measure of control was adopted by the Government of India on December 5, 1941. By this wholesale transactions in wheat at a rate above Rs. 4-6-0 per maund were prohibited. On 28 March 1942 the control price was raised to Rs. 5 per maund. On 24 January 1943, as control was relaxed, the market price of wheat in Lyallpur immediately soared up to Rs. 12 per maund but later it dropped to Rs. 10 which level was maintained till the end of the year. If no control measures had been adopted and the price of wheat had been left to rise, the peasant must have got the maximum benefit by the fullest rise in prices, although it might have affected the consumers adversely. The following Table gives a comparison of the cost of cultivation and net income per acre of important food crops before the war and at present in the Lyallpur Canal Colony. It will serve to indicate the extra benefit derived by the agriculturists during war.

[1] The observations made in this article refer to Lyallpur District but are capable of general application to Canal Colonies.

LEKH RAJ DUA is Agricultural Assistant (Economics) in the Punjab Agricultural College, Lyallpur.

TABLE II

Comparison of the cost of cultivation and net income per acre of important food crops

Name of crop	Cost of cultivation per acre						Gross income per acre						Net income per acre						Increase percentage of net income
	Pre-war			Present			Pre-war			Present			Pre-war			Present			
	Rs.	as.	p.	Rs.	as	p.	Rs.	as.	p.	Rs.	as.	p.	Rs.	as.	p.	Rs.	as.	p.	
Wheat	39	3	9	116	7	2	43	0	0	157	0	0	3	12	3	40	8	10	976·7
Sugarcane	208	4	6	375	11	0	360	0	0	840	0	0	151	11	6	464	5	0	206·0
American cotton	37	0	0	97	5	2	58	0	0	205	0	0	20	14	7	107	9	10	414·3
Desi cotton	33	6	0	77	4	6	40	0	0	101	0	0	6	10	0	23	11	6	258·0
Rice	43	0	0	99	0	0	56	0	0	187	0	0	13	0	0	88	0	0	576·9
Potatoes	168	0	0	377	0	0	400	0	0	1000	0	0	232	0	0	623	0	0	168·5

It is clear from these Tables that prices of wheat and cotton have registered a rise of 350 to 400 per cent and in net profit per acre there has been a rise varying from 168 to 976·7 per cent in different commodities, i.e. irrigated wheat shows a net profit of Rs. 40-8-10 from the pre-war of Rs. 3-12-3 per acre. Rice which used to yield per acre profit of Rs. 13 per acre, now gives the farmer Rs. 88, i.e. 576·9 per cent increase and in case of cotton from Rs. 20-14-7 to Rs. 107-9-10 and similarly there is substantial rise of net income in other crops. The cultivator has, therefore, gained considerably.

The burden of debt has become much lighter as no further debts have been incurred during the war and the debts have shrunk in value owing to the fall in the purchasing power of money. The cultivators have now enough cash in hand and are in a position to pay off their accumulated debts. A random survey of villages unmistakably points to the increased prosperity of the farmer and is confirmed by the statements of responsible officials of the Cooperative Department. More than 50 per cent of the debts due from the villagers to cooperative banks have been paid off during the last four years. They also state that demand for fresh loans has fallen substantially and future prospects of repayment of loans have also become brighter. The following figures of cooperative agriculture credit societies of Lyallpur District excluding Jaranwala tahsil taken from the record of Cooperative Central Banks show the position of loans recoveries and deposits before and during the war :

1. The number of credit societies against which loans were outstanding came down from 423 in 1937 to 218 in 1945.
2. Outstanding loans against societies came down from Rs. 15,28,151 to Rs. 60,62,49, i.e. 60·3 per cent decrease in war days.
3. The Cooperative Department had to write off usually considerable amounts out of the principal of the bad and doubtful debts under liquidation societies. The columns of the bad and doubtful debts show that the situation had much improved in war days. The debts came down from Rs. 68,89,06 in 1937 to Rs. 46,01,27 in 1945, i.e. a decrease by 33·2 per cent.
4. On the other hand there is a great rise in recoveries. In the year 1937, recoveries made against 423 societies amounted to Rs. 30,566 whereas in 1945 the recoveries amounted to Rs. 23,80,37 against 218 credit societies. The total amount of recoveries in the years 1943-45 is 46 per cent more than in 1937-39.
5. Deposits of credit societies which were gradually decreasing, began to increase and came up from Rs. 35,77,49 in 1939 to Rs. 13,41,037 in 1945. The inspector of liquidation societies in the Layllpur District excluding Jaranwala tahsil stated that recoveries made from liquidation societies in the year 1944 amounted to Rs. 50,000 and in 1945 to Rs. 1,00,000 The total was equal to the amount recovered in the last seven years prior to 1944.

TABLE III

Account of credit societies of Cooperative Central Bank, Lyallpur

Year	No. of credit societies	Deposits	Loans outstanding	Doubtful debts	Under Liquidation	Recoveries
		Rs.	Rs.	Rs.	Rs.	Rs.
1937	423	436909	1614548	461994	226912	30566
1938	420	377448	1592776	308128	317994	239948
1939	..	357749	1528151	263818	374451	201908
1941	412	304579	1401290	427312	380696	218223
1942	372	393602	1284352	440189	378156	366405
1943	..	827640	926546	335532	356430	379896
1944	243	1086402	752201	248325	323125	267144
1945	218	1341037	606249	200286	259841	238037

Rise in the value of land

Another sign of the increased prosperity of the agriculturist is that much land has changed hands between 1939 and 1945. As the land values and land rents have gone up very high, many people feel tempted to sell or mortage a part of their property in order to release the rest of the land from mortgage. Several cases of this type have been noticed in the villages. A man mortaged 11 acres of his land for Rs. 8,000 before war, but during the war because of rise in prices the mortgager was able to get five and half acres of his land redeemed from the mortgagee without making any payment, i.e. instead of 11 acres of land five and a half acres were mortgaged for the same amount of Rs. 8,000. Similarly $12\frac{1}{2}$ acres were mortgaged for Rs. 9,000. But during the war $9\frac{1}{2}$ acres were redeemed without any payment and only three acres left under mortgage for Rs. 9,000. There is another interesting case that half square of land which was mortgaged for Rs. 8,000 before the war, was released and remortgaged for Rs. 25,000. Some zamindars gave land to the tenants on $\frac{2}{3}$rd *batai* system against $\frac{1}{2}$ *batai* system prevailing in the locality or on some other hand terms. The following Tables will give us an idea of the rise in value of land in war days. Some villages in Lyallpur tahsil were taken at random for close investigation. The figures for redemption and permanent transfers of land were taken from revenue records.

TABLE IV

Mortgages of land

Chak No.	1936—37 Area	1936—37 Amount	1937—38 Area	1937—38 Amount	1938—39 Area	1938—39 Amount	1939—40 Area	1939—40 Amount	1940—41 Area	1940—41 Amount	1941—42 Area	1941—42 Amount	1942—43 Area	1942—43 Amount	1943—44 Area	1943—44 Amount	1944—45 Area	1944—45 Amount
		Rs.		Rs.		Rs		Rs.		Rs.		Rs.		Rs.		Rs.		Rs.
224	..	..	19	7,600	5	1,200	14	4,239	..	..	33	8,000	3	1,500	83	11,450	2	2,400
213	1	900	63	17,550	13	2,400	91	18,400	..	..	.	..	39	20,450	10	12,000	..	..
214	18	1,580	112	11,250	58	30,108	16	700	..	..	3	260	13	500	..	..	1	1,000
9	12	1,590	11	2,100	13	757	7	375	28	3,044	14	7,500	..	..	6	3,000	..	..
57	39	12,472	..	..	14	3,514	13	2,271	1	70	6	395	58	58,437	40	52,300	20	20,020
100	21	10,544	48	11,400	..	..	46	1,697	7	1,450	69	17,795	11	2,850	7	2,000	26	19,350
58	31	2,600	..	..	18	796	28	6,665	13	1,200	..	..	..	..	5	3,500	..	..
52	20	4,900	3	800	..	..	..	..	14	3,404	..	..	3	2,500	2	2,400	55	52,925

Total from 1936-37 to 1939-40=Rs. 1,58,368 for 735 acres
Total from 1940-41 to 1944-45=Rs. 3,11,700 for 572 acres
Average mortgage money per acre before war=Rs. 215·5
Average mortgage money per acre during war=Rs. 544·9 ($2\frac{1}{2}$ times); 153·9 per cent increase
Average mortgage money per acre in year 1944-45=Rs. 920·1
Average increase percentage per acre in war days=153·990

From this Table we conclude that more acreage of land was mortgaged for less amount in pre-war period whereas less acreage of land has been mortgaged for more amount in the war period. Average mortgage money per acre before the war and at present comes to Rs. 215·5 and Rs. 544·9 respectively representing an increase of 153·9 per cent in the value of land. This is one of the most important reasons responsible for the greater number of redemptions, e.g. releasing 15 acres of already mortgaged land with the same amount obtained by mortgaging only five acres of land at higher value thereby securing an economic holding.

TABLE V

Redemptions of land

Chak No.	1936—37		1937—38		1938—39		1939—40		1940—41		1941—42		1942—43		1943—44		1944—45	
	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount
		Rs.		Rs.		Rs.		Rs.		Rs.		Rs.		Rs.		Rs.		Rs.
124	13	900	7	715	30	4,000	6	405	..	..	31	5,500	65	22,165	21	6,150	3	2,800
121	..	..	58	1,312	..	..	24	4,850	9	2,350	24	2,475	44	13,372	5	3,200	51	21,306
202	10	900	24	6,419	5	2,600	28	8,260	24	3,905	71	21,008	46	6,465	..	..	49	9,854
120	..	..	84	9,960	13	800	56	12,540	14	3,200	47	6,915	138	47,869	40	12,342	33	18,200
117	..	..	..	..	26	6,780	..	..	..	..	28	2,233	6	375	..	..	78	6,366
100	16	1,375	26	2,000	6	4,523	17	870	34	1,700	323	24,420	76	29,750	14	14,000	..	..
214	16	856	64	7,090	41	300	24	1,360	1	100	66	5,090	31	3,800	41	3,000	39	2,408
213	..	..	54	17,500	..	..	193	33,600	41	4,950	..	..	124	35,472	75	20,100	..	..
224	..	..	..	..	20	3,000	24	1,500	28	3,900	49	8,700	34	16,862	110	19,900	..	..
52	..	..	21	2,454	33	7,370	..	..	8	1,600	3	875	7	2,355	32	9,804	78	48,025
58	14	2,200	14	5,000	70	13,000	74	12,617	18	4,515	33	7,200	65	21,720	85	26,125	..	..
57	16	2,726	58	10,070	2	310	53	5,508	15	3,420	14	4,590	134	80,035	64	34,164	24	17,660
9	6	900	25	1,664	13	1,400	13	1,175	32	4,328	3	450	45	14,040	6	550	..	..
Total	91	9,857	435	75,984	259	46,792	512	82,685	224	34,038	692	89,456	805	2,94,280	493	1,49,335	295	1,26,619

Total acreage redeemed from 1936-37 to 1939-40 = 1297 acres. Average per year = 324·25 acres
Total acreage redeemed from 1940-41 to 1944-45 = 2509 acres. Average per year = 627·25 acres
Maximum redemption of land has been found in year 1942-43, i.e. 805 acres as compared to the average figure of 324·25 acres before war and 627·25 acres in war period per annum. Average increase in the redemption of acreage under land is by 93·5 per cent in war days.

TABLE VI

Permanent land transfers (sales)

Chak No.	1936—37		1937—38		1938—39		1939—40		1940—41		1941—42		1942—43		1943—44		1944—45	
	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount	Area	Amount
		Rs.		Rs.		Rs.		Rs.		Rs.		Rs.		Rs.		Rs.		Rs.
124	..	..	..	..	..	..	3	900	..	..	44	31,296	13	11,440	..	..	3	2,410
121	..	..	28	11,975	..	..	19	11,660	3	1,000	3	1,970	12	11,800	12	11,310	46	76,222
202	..	..	44	28,698	15	8,483	..	..	12	3,950	9	1,900	4	4,202	..	..	11	10,595
120	..	..	1	100	25	12,089	34	17,417	11	6,700	23	14,480	46	44,592	2	1,325	5	3,800
117	..	..	3	1,000	1	110	..	..	..	..	..	..	..	..	..	..	2	1,200
214	..	..	43	20,830	29	19,957	..	..	9	3,945	11	5,814	10	5,048	9	6,000	..	..
213	..	..	..	..	..	..	..	..	..	..	..	..	13	24,082	2	3,200	3	10,200
224	..	..	38	25,987	7	5,937	..	..	3	3,403	28	38,301	98	79,980	21	25,700	..	..
52	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
58	56	31,668	13	9,651	13	7,500	37	19,000	..	..	..	..	22	24,030	9	12,900	..	..
57	..	..	14	8,822	..	..	..	..	14	8,000	..	..	..	..	..	..	..	..
100	35	14,360	10	4,292	5	2,273	..	..	..	..	12	4,872	30	40,663	8	14,000	9	9,000
9	..	..	1	884	3	2,003	3	1,280	..	..	..	..	..	..	..	..	6	8,705

Average price per acre before war = Rs. 549·5
Average price per acre during war = Rs. 963·6
Average price per acre in 1944-45 = Rs. 1436·8

The above figures show the average increase in purchasing value of land in war days by 75·40 per cent as compared with pre-war days. We also find that value of land has been enhancing year by year in war period till it came to Rs. 1436·8 per acre which is the average figure for year 1944-45. Rise in the value of land is also mainly responsible for greater redemptions of land.

Rise in prices: a mixed blessing

It is very difficult to estimate exactly the extent of net advantage derived by the agriculturist from the present rise in prices, but it can be asserted that a distinct improvement in his position has begun in a number of ways as seen above, i.e. the cash value of crops having increased, he has obtained relief in debt and the real burden of debt has become much lighter. Their deposits in banks have increased. The self-sufficing agriculturist by the sale of surplus produce has been able to put some more money in his pocket without being much adversely affected by the high prices of his necessities. The recruitment to the army has also taken place from this community resulting in the inflow of wealth. There is no doubt as Tables IV to VI indicate that land values have gone up to a limit previously unknown and therefore redemptions of land have been much greater than before the war.

'Travel less' campaign has its worst enemies in this class and all pre-war schemes for pilgrimages, courtesy visits to distant relations, etc. have been fulfilled in war time. The cultivators have been spending liberal sums on social functions. Drinking has increased as is borne out by the officials of the Excise Department. Their visits to grand hotels in the cities have also been noticed in war days.

The revenue officials say that collections have not only become easier, more prompt and regular, but the pressure of officials as a factor in revenue realization has disappeared in many places. Instead of the Lambardars going to the farmer and compelling payment of *kist* through persuasion and threat many villagers have been found seeking the village officers to pay up their dues.

There is a dark side of the picture as well. In any other country a rise in agricultural prices would mean an increased income and prosperity for the agriculturists as a class as well as for most individuals.

In our country on the other hand it means an increased income only for a small section consisting of big farmers and land lords. The progressive sub-division and fragmentation of land has made war-time prices an illusory advantage to many farmers. A substantial percentage of the producers of the food crops consists of those who have small and uneconomic holdings and therefore they have not been able to derive any genuine or permanent advantage. In fact they are in agriculture not for business but for getting a living. Disproportionate rise in the cost of goods and services which the cultivators have to purchase, has rendered the position worse. The price control over the agricultural commodities has always been more vigorous and effective than the control over other consumers' goods. There are actually many small farmers who carry on agriculture as a subsidiary occupation producing whatever they can and purchasing food from the market from their slender incomes from other sources, such as purchasing and selling of milch cattle, carting of agriculture produce, etc. and thus have been able to keep their body and soul together with difficulty. For example, in the Lyallpur Canal Colony the price of wheat has had a rise from 300 to 400 per cent whereas the price of cattle has gone from 600 to 700 per cent.

Slightly better than this is another group which consists of cultivators who have a small surplus over their food requirements and which they dispose off to enable them to purchase other necessaries of life. Sometimes they have to make purchases at black market prices although they also sell their produce sometimes at black market rates when there is a paucity of things. This was the case in February and March 1946. The condition of the producers of cash crops like vegetables round about cities is decidedly better because they obtain higher prices and get much more net profit per acre than in the pre-war period. The big farmers and landlords have benefited to a great extent from this situation because of having economic holdings. The cultivator would have gained as well if the prices of agricultural produce alone had gone up immediately or at least stood at a considerable higher level than those of other commodities.

To sum up, the effect of war on the agriculturist has been to the cultivators' advantage and especially in the case of the bigger farmers having more surplus to dispose off at higher prices and getting other articles at controlled rates through their personal influences. It can be called a period of temporary boom in the agricultural industry.

TRIALS AND TRIBULATIONS OF AN AMATEUR GARDENER

By ADI K. SETT

THROUGH sheer fortitude, patience and persistence, Mr. Stanley Jepson, Editor of *The Illustrated Weekly*, has achieved notable agronomic results on a small plot of land at Matheran, the hill-station near Bombay.

Journalist turned farmer

Today, one of India's most vital problems is food. She is facing a critical famine and there is tremendous propaganda throughout the land for growing more food and turning flower gardens into vegetable patches. Therefore, what Mr. Jepson has executed in the face of many difficult and abnormal conditions in the jungle should be an incentive and an inspiration to those living in cities and in better agrarian zones. At the outset Mr. Jepson emphasized that he was 'no farmer but a journalist and an editor'. But gardening is one of his many hobbies.

The plot of land, planted with flowers, fruits and vegetables, always proves to be a centre of attraction at the hill-station, which is a little over two thousand feet above sea-level. Approach is only by rail. There is no motor road.

The soil

For over two years, Mr. Jepson has been working hard on his land. He told me that four years were required, if not more, to make an agricultural success of the plot as he had to experiment from one season to another. Circumstances were difficult and there was no cultivation on this rocky hill top and certainly there were no fruit orchards. The most important odds against which a cultivator in such conditions has to struggle is the soil itself. It is highly porous murram and, therefore, extremely difficult to work. 'You should bear one factor in mind', Mr Jepson said to me, 'the land around here is mostly rocky. The more you dig, the more you come across great boulders and pieces of rock. It is crowbar work!'

From the middle of June to the end of September, the incessant and heavy rainfall on this hill averages about two hundred and sixty inches, with almost no rainfall during the other months. The conditions are certainly abnormal but with courage and the will to overcome them, one can attain some measure of success as Mr. Jepson has done.

The forest land, below the property, overlooking the brown valley and facing the mauve mountains, was cleared and levelled. The next item of work was to dig a well which is about thirty five feet deep, and often full during the rainy season. Here, our experimental gardener obtained much practical experience: 'I learned quite a lot about things of which I was totally ignorant, centrifugal pumps and pump lifts, driving a pump from a petrol engine on the well-wall, pipes and rates of water flow, overhead irrigation.'

There were trials and disappointments of course. The pump was fixed lower and instead of obtaining 20 gallons of water per minute, as promised by the manufacturers, Mr. Jepson obtained double the quantity. The water goes into a highly placed tank, thence into one-inch pipes to the other end of the land and from there into various cement tanks. Subsoil irrigation is strongly recommended by Mr. Jepson. Near the well is an inscription from Cato: 'The Best Citizens Spring From The Cultivators.'

The soil, as stated, is not too suitable for agrarian purposes, and is not old enough. It had to be improved with humus. Stable manure was imported from a distant spot by head loads and was found to be too expensive. So Mr. Jepson tried to get regular van loads by the local metre gauge train from Neral but that was even more costly. Mr. Jepson finds that night-soil (also known as bathroom manure) is very useful when trenched in certain places. He has also tried, with some success,

green manuring. And he thinks that humus, can best be added by means of compost obtained from forest leaves, undergrowth, etc. He has made experiments with different compost activators, but has emphasized that in such heavy monsoon weather, the compost heaps or pits should be drained at the bottom and earthed over, to prevent the necessary salts and soil foods from being washed away.

I asked Mr. Jepson whether he used any chemicals to stimulate the land. He said he did so very seldom and very little. 'When you know', said Mr Jepson, 'that the heart in a person's body is weak and you dose him with a stimulant, it does little good to him. The question is to improve the person's physical condition. So with the land. Good and plentiful manure is needed. There are some excellent fertilizers but they do little good when the soil is not in good heart.'

Vegetation

Questioned as to what fruits grow best in these conditions, Mr. Jepson said, 'Bananas and papayas grow most rapidly, though the latter get damaged by the heavy and destructive rains, winds and gales.' Citrus fruits like oranges, limes, grape fruit are still growing; custard apples, phanus (jack fruit), chickoos, guavas, cashew nuts, mulberries, mangoes (there are gigantic wild trees on the hill), *litchies*, cape gooseberries, potatoes, sweet potatoes, (here rats are most destructive and will not leave these plants alone unless rat poison is freely spread among them) and tapioca grow abundantly and seem to thrive in spite of the heavy elemental odds.

Insect and other pests

It is not only the elements that seem to conspire against any agricultural success or agronomic improvement on this forest-hill; there are the denizens of the forest. Mr. Jepson sighed as he talked at length about monkeys, most pestilential in this category, who raid the local gardens in regiments. To shoot them is forbidden as they are considered sacred, and so he intends to put up a 6-volt electric wire atop or a wire fence so that these little fellows will get slight shocks and desist from their raids. He has thought a great deal about these pests and has not yet found the answers. There are many thousands of monkeys on the hill top. A monkey is an extremely mischievous animal. He will destroy whole rows of vegetables for mere fun before he eats one leaf.

Just after the monsoon, grasshoppers and locusts come in hordes and destroy young leaves. Hares, big jungle rats and porcupines will also do their bit in waging war on plants.

Mrs. Jepson's preserve

The top flower borders are Mrs. Jepson's preserve and she finds that among other things flowering shrubs and hydrangeas, begonias, delphiniums, double petunias, pansies and roses bloom in abundance. I have seen even beautiful orchids in the local forest and many monsoon ferns and wild flowers.

The poultry is worth noting. Splendid specimens of Leghorns and Rhode Islands do their part bravely and Mrs. Jepson told me that she had been told 'they'll all die in the rains', but they did not die. They have free range in the forest and get plenty of young green stuff and insect life, the natural food of the wild jungle fowl of which there are some in the forest round about. Here again, monkeys steal the eggs if you will let them.

The Jepsons pay visits to this place only at week-ends and that too very irregularly, once or twice a month, or when they can snatch a short spell to the hill. But in spite of the infrequent and comparatively little attention paid, they have achieved results worth noting.

The gardener's dream

'My wife and I have rejuvenated ourselves by wrestling with countless obstacles and problems', said he to me. 'We have never thought of giving up in despair', he added with firmness and conviction. 'Regrets? Never! We hope to have an orchard, an apiary and bees can thrive here wonderfully on flowering trees like the *jambuls* and *anjani* which are plentiful. We will enlarge our poultry, keep ducks in this cement pond, and will have plenty of liquid manure', Mr. Jepson said with a youthful and a refreshing zest.

'One thing I found', said Mr. Jepson, 'was that though I bought books on gardening from every bookshop I could find, I discovered nothing about gardening in such torrential rains. There was gardening in the desert, in the heat of the plains and in the hills. But no guidance about 250-inch monsoon conditions.

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INDIAN FARMING

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PLANNING AND THE VILLAGER

IT needs to be hardly stressed that the foremost task before the country is to develop her primary industry, agriculture. As a result of food shortage, agriculture has been able to draw the attention of even the sophisticated citizen who till now was unaccustomed to think of his food supplies in terms of land and plough and cattle. It is a happy sign of times that increasing attention is being paid to agricultural development for in this lies not only the prosperity of the country but also the health and happiness of its people.

Planning has been recognized as an essential prerequisite to any developmental programme; this is more so in the case of agriculture for agriculture connotes a complex interaction of innumerable conditioning factors and a planned scheme, if any were needed, is more incumbent in this case than in any other. This is also the reason why planning in the domain of agriculture presents special difficulties. A plan which does not take into consideration even one—not to speak of more—apparently negligible factor is foredoomed to failure. All the contributing factors must be viewed in their proper perspective, weighed, evaluated and given the attenton they are entitled to.

In planning for agricultural development, attention too often is limited to the plough and the land it tills; the man behind the plough is frequently overlooked as if he were of no consequence. Such an attitude is unfortunate and betrays a lack of appreciation of the problems involved. For the person, who drives the plough across the field, serves also to provide the necessary dynamism to all the heterogenous operations that together constitute agriculture. To neglect him, or even to relegate him to a secondary position, is to deny the very foundation of progressive agriculture.

In India, more than probably in any other country, the development of agriculture is intimately connected with the well-being of the masses. These are the people who form the backbone of agriculture in this country. And yet they live in abject poverty, are ignorant and are in many cases denied the basic necessities of life. All planning programme in this country in order to be really effective must therefore take proper notice of the common man.

The common man in India lives in its more than 700 000 villages scattered throughout the country. The common man in India stands badly in need of food and clothing and leisure and a reasonable standard of health. Above all he has a very insecure economic background with a pressing load of debt and the persistent grip of the money lender ever tightening its hold on him. From all these he wants an escape. And unless this is assured, all planning is bound to end in an utopian muddle. The farmer or the villager cannot be interested in any progressive programme unless it conveys to him the promise of freedom from want and disease and fear with a certainty which can convince him. Moreover, the peasant tills the land and makes it productive not only for himself but also in the larger interests of the whole country. Therefore in any scheme for the development of the country, the needs

and problems peculiar to the farmer must be given priority of consideration.

It is essential that targets of production will have to be fixed in any attempt to relieve the peasant of his perennial sufferings, and unfailing efforts will have to be made to translate these into reality. So long as these targets remain unattained all talk of planned progress will remain barren and elusive. It is therefore necessary that the targets should be so fixed that they are capable of attainment,—not so low as to appear meaningless and bereft of imagination, nor so high as to court failure and disappointment. Either of these phases is naturally pregnant with dangerous potentialities and is calculated to set up psychological reactions daunting the spirit and enthusiasm of the peasant—that pliable human material which essentially contributes to the success of all cooperative endeavours.

In order to win the confidence and active cooperation of the farmer any scheme of planning and reconstruction had better be built up from below upwards rather than a chiselled and balanced blue-print foisted from above on an ignorant and unwilling mass who had not been taken into confidence in its shaping. The peasant has no idea as to what it is meant for, how far it will go towards improving his condition and the extent to which it will be helpful to the larger interests of the country and the society. The farmer has a conservative mental make-up as is natural to people of his calling; he is therefore not prompt in his grasp of ideas especially foreign to him and consequently his reaction towards these is bound to be slow, cautious and calculating. He must be convinced of the utilitarian value of a scheme before he can be expected to act and harness his energy in a desired direction. And in order to convince him, all ideas and schemes of planning must be presented to him in a manner which he can easily comprehend and which must be devoid of all authoritarian attitude. An abundance of sympathy with the villager and an intimate understanding of his ways and habits should necessarily underlie any effort which is tuned to his betterment and welfare. Unfortunately this consideration of human values has been sadly lacking in many a well-meaning scheme which has of late been put forward.

Original Articles

PHOSPHATE MANURING OF LEGUMES FOR INCREASED FOOD AND FODDER. III

By C. H. PARR & R. D. BOSE

ACCOUNTS have already been given of the striking effects of phosphate fertilizers when applied to berseem (*Trifolium alexandrinum*). Under the conditions of the experiments carried out at New Delhi, superphosphate alone or in combination with organic manures produced luxuriant growth in berseem and more than doubled the yields. Without the addition of any further fertilizers or manures, the yields of the following crops of wheat in the plots to which phosphate had been applied to berseem in the previous years, were more than 100 per cent higher than where wheat followed unmanured berseem. Wheat followed berseem in (1) a doubled cropping, cowpea-wheat rotation and (2) a fallow-wheat roation. The yields of berseem and cowpeas grown in rotation are given in Table I.

TABLE I

Three year average yields of berseem and cowpeas (green fodder 1940-41 *to* 1942-43)

Manures applied each year to berseem only for 3 years, 1940 to 1942 in maunds per acre		N. P. K. contents of manures applied			Average yield of green fodder maunds per acre: Berseem — Average of 3 years 1940-41 to 1942-43	Average yield of green fodder maunds per acre: Cowpeas — Average of 3 years 1941 to 1943
		N	P_2O_5	K_2O.		
L. No manure		...	...	...	161	106
A. Farmyard manure	97	40	28	60	263	129
B. ,, ,,	194	80	56	120	324	136
D. Activated Sludge	43	80	56	64	295	127
E. Rape cake	15	80	32	16	334	130
F. Sulphate of ammonia	4.6	80	...	...	169	120
K. Complete artificials:						
Sulphate of ammonia	4.6					
Superphosphate	1.7					
Sulphate of potash	2.9	80	56	120	366	142
C. Farmyard manure	291	120	84	180	359	133
G. Superphosphate	4	...	132	...	336	120
H. ,,	6	...	198	...	378	125
I. ,,	84	...	264	...	369	132
J. Superphosphate and Farmyard manure	194	80	188	120	414	138

(1 maund-82.3 lb.)

Parr, C. H. & Bose, R. D. Phosphate Manuring of Legumes, I & II, *Indian Farming*, Vol. V, No. 4, April, 1944, 156-162 & Vol. VI. No. 5, May, 1945, 201-208.

C. H. Parr, I. A .S. is Head of the Division of Agriculture, I. A. R. I., New Delhi, and R. D. Bose, B.Sc. is Secretary, Indian Central Sugarcane Committee, New Delhi.

Table I shows that the berseem was grown in rotation with cowpeas for three consecutive years 1940-1941 and 1942. The berseem crop only was manured. No manures of any kind were applied after 1942. The subsequent cowpea and wheat crops (Table II) were grown on whatever fertility had been built up and left behind by the berseem and cowpea crops during the period 1940-42. The particularly healthy appearance of the 1943-44 wheat crop in the phosphate treated plots clearly indicated that the built up fertility in these plots was by no means exhausted by this single crop of wheat or by the double cropping of cowpea (*kharif*) followed by wheat (*rabi*). Another crop of wheat was taken in 1944-45 in the same two rotations (a) fallow-wheat and (b) cowpea-wheat which was again repeated in 1945-46, to test the extent of the soil fertility which this system of cropping and manuring had clearly created. The results are given in Table II.

TABLE II

Yields of wheat in the Rabi 1943-44, 1944-45 and 1945-46 and *cowpeas in the intervening* Kharif, 1944 *and* 1945

Manures applied per acre to berseem in each of the previous three years	Average yield in maunds per acre								
	Green cowpeas	wheat P6. C. 518 (grain)							
	Average yield of 2 years 1944 & 1945 in rotation with wheat	1943-44		1944-45			1945-46		
		After one fallow	After cow-peas	After two fallows	After one fallow	After cowpeas	After three fallows	After two fallow	After cow-peas
L. No. manure	164	24.0	14.9	25.6	25.3	14.7	24.8	22.9	14.2
A. Farmyard manure 40 lb. N.	194	20.2	16.7	24.7	17.6	15.8	24.3	29.8	17.3
P. ,, 80 lb. N.	203	27.0	20.9	34.5	30.7	18.1	35.3	39.5	19.4
D. Activated Sludge 80 lb. N.	195	26.6	23.1	31.1	28.7	20.1	34.4	32.1	22.2
E. Rape cake 80 lb. N.	185	28.6	16.1	29.1	26.9	15.0	29.2	25.8	16.1
F. Sulphate of ammonia 80 lb. N.	214	21.0	15.2	27.8	19.9	16.7	24.2	19.1	20.4
K. Complete artificials on the basis of treatment 'B'	204	31.3	23.9	32.3	35.2	27.1	28.2	39.0	20.6
C. Farmyard manure 120 lb. N.	218	27.5	22.3	30.7	31.3	23.8	27.3	29.0	20.3
G. Superphosphate 132 lb. P 205	200	30.8	24.2	38.1	32.1	27.3	27.9	31.4	21.9
H. ,, 198 lb. ,,	206	29.9	26.2	36.3	34.1	32.6	33.4	28.2	27.3
I. ,, 264 lb. ,,	204	29.7	25.5	39.0	36.7	36.1	29.8	33.6	27.9
J. ,, 132 lb. ,, +Farmyard manure 80 lb. N.	208	25.5	26.4	40.3	36.7	32.9	35.4	34.5	24.9

Compared with 1943-44, the yields of the 1944-45 wheat crop are all considerably higher. Some of this increase may be attributed to the effect of season, since 1944-45 was a season of a good *rabi* cereal yields in the area concerned. It will be noted, however, that in the plots which were either unmanured or treated with manures containing little or no phosphate as A. E. and F. (Farmyard manure 40 lb. N; Rape cake 80 lb. N; Ammonium sulphate 80 lb. N), this increase amounts to only 2 to 14 per cent in the cowpea-wheat rotation and 4 o 14 per cent in t fallow wheat. The extent of the favourable seasonal effect in the low phosphate plots is limited to this amount.

Need for soil fertility.

The yields in the phosphate-treated plots, treatments G and I on the other hand are 86 to 146 per cent greater than that of the 'no manure' plot, showing not only that a very stable and effective type of frtility had been built up but that it was such as enabled the maximum

utilization of the advantages offered by weather conditions favourable to the wheat crop, which is further confirmed by the 1945-46 yields. The importance of this aspect of soil fertility has not been sufficiently appreciated in this country, where soil fertilizing practices tend to be of a hand to mouth type, based on the quick return or short term view. A soil low in fertility, is quite unable to respond fully in crop yield in those years when nature is in a generous mood, and though some increases in yield may be obtained, these seldom represent the full measure of what is possible when the influences of a favourable season act in combination with all the crop producing forces at work in a really fertile soil.

Economics

The cost of superphosphate added and the value of the increased yields of wheat, both grain and straw, are given in Table III.

TABLE III

Cost of superphosphate and the value of the increased yield of wheat

Superphosphate added per year	Superphosphate added in 3 years	Increased yield of wheat per acre over no manure, in 3 years		At pre-war prices: Cost of superphosphate added at Rs. 5-8-0 per maund	Value of increase in grain and straw, wheat at Rs. 3 and straw at as. 8 per maund		Total	Difference between value of increase in grain and cost of superphosphate	Difference between value of increase in grain and straw and cost of super phosphate	At present prices: Cost of superphosphate added at Rs. 10-5-6 per maund	Value of increase in grain and straw; wheat at Rs. 10 and Straw at Re. 1 per maund		Total	Difference between value of increase in grain and cost of super phosphate	Difference between the value of increase in grain and straw and cost of superphosphate
		Grain	Straw		Grain	Straw					Grain	Straw			
md.	md.	md.	md.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
4	12	29.6	54.2	66	88.8	27.1	115.9	+22.8	+49.9	124.1	296	54.2	350.2	+171.9	+226.1
6	18	42.3	79.4	99	126.9	39.7	166.6	+27.9	+67.6	186.1	423	79.4	502.4	+236.9	+316.3
8	24	45.7	82.8	132	137.1	41.4	178.5	+5.1	+46.5	248.2	457	82.8	538.8	+208.8	+291.6

1 maund = 82·3 lb.)

It will be seen that even at pre-war prices, the increase in wheat yields in the phosphate-treated plots even at the high dose of 8 maunds superphosphate per acre is sufficient to pay for the cost of all the phosphate applied over the previous period of three years and leave a profit.

The appearance of the crops in the high phosphate plots moreover indicates that thers is still a reserve of unused fertility here at the disposal of future crops.

Price relation of nitrogen and phosphate

In America it has been estimated that 1 lb. of phosphate when applied to the legume lucerne, results in the accumulation of 3 lb. of nitrogen in the soil. In India the pre-war price of nitrogen was five annas per pound (Ammonium sulphate Rs. 5 per maund), that of phosphate (P_5O_2) 2.75 annas per pound (double superphosphate at Rs. 5—8 per maund). In terms of money an investment in phosphate of 2.75 annas could thus produce a return in nitrogen of 15 annas. It is this favourable exchange of P_2O_5 into nitrogen which is the source of the profits indicated above.

The average yield of irrigated wheat in the Punjab grown in the usual cropping rotations is reported to be 11.3 maunds per acre. If the yield of three years wheat in the phosphate-treated plots is averaged over six years, i.e. to cover the period when berseem was grown for three years, the average yield per acre for the six-maunds superphosphate treatment comes to 14.35 maunds. In this rotation, over and above this, was also produced 1,134 maunds of berseem and 786 maunds of cowpeas of which 651 maunds of berseem and 140 maunds of cowpeas represent the increases over the 'no manure' plots as a result of the application of 18 maunds of superphosphate. Table IV shows the approximate value of this increase in fodder in terms of linseed cake.

Looked at from this angle, the results indicate a manner whereby India can increase production of both grain for human consumption and suitable fodder for cattle population at one and the same time.

Table IV

Value of the increased yields of berseem and cowpeas in terms of linseed cake

Manurial treatment per acre (applied to berseem)	Total yield in maunds per acre: Green berseem in 3 *rabi* crops	Total yield in maunds per acre: Green cowpeas in 5 *kharif* crops	Increase per acre over 'no manure': Green berseem md.	Increase per acre over 'no manure': Green-cowpeas md.	Increase per acre over 'no manure' shown as digestible protein (A) (lb.)	Increase per acre over 'no manure' shown as digestible protein (B) (lb.)	Quantity of linseed cake per acre required to provide the digestible protein equal to increase over 'no manure' (A) (md.)	Quantity of linseed cake per acre required to provide the digestible protein equal to increase over 'no manure' (B) (md.)
No manure	483	646	...	...	...	...	...	...
Super 4 md.	1009	759	526	113	1434.5	449.4	74.9	23.5
Super 6 md.	1134	786	651	140	1776.0	556.3	92.7	29.1
Super 8 md.	1106	802	623	156	1741.y	541.5	90.7	28.3

NOTE: (A) denotes quantity per acre in 3 *rabi* and 5 *kharif* crops while (B) denotes quantity per acre in 1 *rabi* and 1 *kharif* season.

Effect of manuring berseem with lower doses of phosphate.

High doses of superphosphate, viz. 132, 198 and 264 lb. P_2O_5 (4, 6 and 8 maunds) per acre were used for manuring berseem in the experiment detailed above. Another series of experiments was, therefore, started a year later, i.e. 1941-32 with lower doses of phosphate as superphosphate or farmyard manure and in certain combinations of the two, to study the effect of continuous application of phosphate on the yield and composition of the legumes berseem and cowpea. Similarly in this case three manured crops of berseem were followed by three unmanured crops of cowpeas and in 1944-45 wheat was grown in these plots for the first time. The yields obtained from all the crops are shown in Table V.

Table V

Yields of berseem, cowpeas and wheat from manurial experiment No. 2 *during the period* 1941-42 *to* 1945-46

Manurial treatments per acre applied each year to berseem only, for 3 years, 1941 to 1943	Weight of manures in maunds applied per year: F.Y.M.	Weight of manures in maunds applied per year: Superphosphate	Average yield in maunds per acre: Green berseem — Average of 3 years 1941-42 to 1943-44	Green cowpeas — Average of 3 years 1942-44 in rotation with berseem	Green cowpeas — Yield in 1945 in rotation with wheat	wheat PB. C. 518 (grain) 1944-45 — After cowpeas	wheat PB. C. 518 (grain) 1945-46 — After one fallow	wheat PB. C. 518 (grain) 1945-46 — After cowpeas
F.Y.M. at 16 lb. P_2O_5	64.30	...	225	171	194	25.9	30.9	16.2
,, 32 ,,	128.60	...	257	175	203	31.8	33.8	22.5
,, 64 ,,	257.20	...	303	184	227	31.2	34.7	20.0
Superphospate at 16 lb. P_2O_5	...	0.50	256	177	186	27.9	31.2	12.4
,, 32 ,,	...	1.00	318	178	196	31.9	34.0	11.6
,, 64 32 ,,	...	2.00	354	180	225	41.2	37.7	27.3
Super at 8 lb. P_2O_5+E. Y. M. at 8 ib. P_2O_5	32.15	0.25	274	168	202	26.9	31.3	27.6
,, ,, 24 ,,	96.45	0.25	281	179	215	30.8	28.6	19.4
,, ,, 56 ,,	225.05	0.25	339	183	197	38.2	41.5	22.9
F.Y.M. at 8 lb. P_2O_5+Super at 24 lb. P_2O_5	32.15	0.75	303	172	199	29.9	31.6	21.6
,, ,, 56 ,,	32.15	1.75	350	189	209	38.3	39.6	27.6
No manure	...	...	169	173	171	25.3	30.7	17.3

Here again berseem manured and wheat grown on the residual effect of manured berseem and unmanured cowpeas show clear and definite responses to the higher doses of phosphate manuring, but in the case of cowpeas similar responses are again markedly absent. For the same amount of phosphate, superphosphate has generally shown higher crop yields than farmyard manure, though the differences in yields are not statistically significant in all cases. In the case of wheat significant increases in yield over that of the 'no manure' control were obtained whenever the dose of phosphate was 64 lb. P_2O_5 per acre either in the form of superphosphate alone or as superphosphate in combination with farmyard manure. This indicates that a dose of 64 lb. P_2O_5 or about 2 maunds of super-phosphate (38 per cent P_2O_5 per acre applied in three consecutive years represents the basic level of phosphate requirement of the berseem crop in the Delhi Farm soil. Even at this dose the yields of berseem showed a tendency to decline during this three-year period, but those of the cowpea remained fairly uniform. This suggests that the berseem was using up

the soil phosphate and that 64 lb. P_2O_5 per acre per annum was inadequate. The necessity for a high initial basic phosphate dressing is indicated.

The lower doses of superphosphate in combination with farmyard manure in this experiment have given good yields of wheat and fair yields of berseem. It will be noted in Table I that treatment 'J' (superphosphate 4 maunds —F.Y.M. 194 maunds) has given consistently good results, the highest yield of berseem and the second best in wheat. The yields of the 'complete artificials' treatment in this connection are of interest. The amount of P_2O_5 added is only 56 lb. a year comparable to the amount of P_2O_5 added in the low phosphate experiment. It would appear from these results that other factors are operating besides phosphates. The consistently good results of treatment 'J' in support of those of treatment 'K' suggest that potash may play a part. This aspect is under investigation.

Berseem in rotation with maize and wheat

Table VI gives the yields obtained in an experiment to test the effect of phosphate in different forms, when applied to the berseem crop on maize and wheat grown in the following *kharif* and *rabi* seasons. Yields were obtained as presented in Table VI.

Table VI

Yields of manured berseem and unmanured maize and wheat

Treatment per acre applied to berseem only in 1944-45	Average yield in maunds per acre			
	Green berseem *Rabi* 1944-45 (manured)	Maize grain *Kharif* 1945 (unmanured)	Wheat grain *Rabi* 1945-46 (unmanured)	Combined yield of maize and wheat 1945-46 (unmanured)
No manure	139.7	24.1	22.7	4.8
Bonemeal at 120 lb. P_2O_5	172.6	22.9	27.4	50.3
Ammonium Phosphate at 120 lb. P_2O_5	262.8	28.5	25.7	54.2
Superphosphate at 120 lb. P_2O_5.	144.1	21.1	22.3	43.4
Bonemeal and Ammonium Phosphate each at 60 lb. P_2O_5	191.7	23.1	26.7	49.8
Bonemeal and Superphosphate each at 60 lb. P_2O_5.	161.9	23.4	28.1	51.5

Owing to the late arrival of supplies of superphosphate this fertilizer was applied late and the increases in yields from this treatment are not of the order of those obtained when superphosphate was applied at the proper time, that is, at or before sowing the berseem crop. The yields obtained under this treatment, however, are on a level with those obtained from bonemeal alone which manure is known to require time to become available. Ammonium phosphate on the other hand, has shown clear responses, producing 88 per cent increase over the 'no manure'. The response of berseem to ammonium phosphate is of special interest. Besides the 20 per cent P_2O_5 this fertilizer contains about 17 per cent nitrogen. Other experiments have shown that the berseem crop can, in its early stages, make considerable use of a ready supply of nitrogen whenever it is associated with available phosphate. Similar results can be obtained when equivalent amounts of nitrogen and phosphate are applied in the form of ammonium sulphate and superphosphate. The results given in Table I show that the berseem crop can make no corresponding use of nitrogen when it is applied alone as sulphate of ammonia. The idea of applying nitrogen to a legume crop is contrary to general agricultural opinion, but whether the practice is sound or not, depends on the contribution the added nitrogen in association with phosphate will make, not merely to

increase the yield of berseem but to the final soil fertilizing effect of the crop, which is as important as its immediate yield.

When the yields of maize and wheat under this double cropping system are added together as shown in Table VI, yields up to 54.1 maunds were obtained in the ammonium phosphate-treated plots. In an adjacent plot, where maize and wheat were grown in rotation for two years without manuring the yields obtained per acre were as follows:

1944-45	...	Maize	14.6 maunds.
		Wheat	13.9 ,,
1945-46	...	Maize	11.8 ,,
		Wheat	12,5 ,,

The total yield from the four crops in two years amounts to 51.8 maunds per acre. In the berseem—maize—wheat rotation the combined yield of maize and wheat in one year is 54.1 maunds in the ammonium phosphate-treated plots. In addition to this, these plots produced 262 maunds of green berseem. Moreover there is in these plots still a reserve of fertility for future crops. These experiments were laid out to show that fertility building begins immediately when berseem is grown in the presence of adequate supplies of phosphate either added or already present in the soil. The amount of fertility so built up will doubtless depend on the amount of phosphate present or added and on the frequency with which the legume occurs in the rotation.

The same action of ammonium phosphate has been brought out in regard to other winter legumes such as lucerne, *senji* (*Melilotus alba*), *methra* (*Trigonella Foenum graecum*), peas and gram which also have shown responses to superphosphate alone but hitherto of a lower order than berseem.

Table VII

Effect of superphosphate and ammonium phosphate on winter legume 1945-46

	Average yield in maunds per acre		
	No manure	Superphosphate 120 lb. P_2O_5	Ammonium Phosphate 120 lb. P_2O_5
Lucerne (green fodder)	141.1	267.2	294.7
Senji ,,	180.7	241.9	271.5
Methra ,,	169.1	226.3	264.8
Peas I. P. 29. (seed)	12.9	16.2	15.7
Gram I. P. 58. (seed)	14.7	18.7	18.4

(1 maund-82.3 lb.)

Importance to India of increased soil fertility

India's food position now demands (1) a very considerable increase in cereal, vegetable oil and protein foods for an ever-growing human population, the requirements of which already exceed the capacity of the present cultivated areas, and (2) a considerably increased production of milk and dairy products, that is, those protective foods essential for the maintenance of good health.

For an adequate milk supply, better milking cattle will be needed, which in turn, will require fodder production on a much larger scale. The question as to how India can increase production in both grain for human consumption and suitable fodder for the cattle population at one and the same time, is becoming increasingly urgent and important. Although the problem is by no means new, and much consideration has already been given to it, practical measures to produce more fodder from the limited cultivated area without loss

of food grain have hitherto not been forthcoming. Viewed from the angle of the results of these experiments the problem does not appear insoluble. The legumes produce protein for food and fodder and enrich the soil with nitrogen for cereal food production as they grow. The particularly high efficiency of berseem in this respect is clearly brought out in these experiments. The present low level of yields of crops in India is mainly due to the fact that the bulk of Indian soils are depleted and farmed out. Fertility is largely synonymous with the presence of adequate supplies of nitrogen in organic as well as in inorganic forms. With the aid of adequate supplies of avail able phosphate, these experiments show that the legumes can build up large quantities of nitrogen in a form which is at the disposal of succeeding food crops, such as wheat, paddy, potatoes, sugarcane and maize.

India's food and fodder position cannot be secured until her present soil-depleting systems of crop husbandry are changed and replaced by soil fertility building system. Over large areas Indian soils under continuous cropping are doomed to low yields. Even the recuperative effect of fallows is insufficient to prevent this. The immediate demands on the land moreover will render fallowing less and less possible. The use of phosphates in conjunction with efficient nitrogen-fixing legumes, fodder legumes and legumes used as green manure crpos will reverse the process and ensure a rising plane of soil fertility and increased yields of all the cereal crops which fallow. Such practices must be made the basis of every cropping rotation.

Without added phosphate the legumes in the usual cultivators' rotations fix too little nitrogen to be really effective in fertility building. They barely maintain the *status quo*. If a high level of soil fertility is not secured, India's food cannot be assured as the demands on the soil are now too heavy and are increasing year by year.

The quickest and cheapest way to regain the lost fertility, and to build up more, is to give the soil its requirements of phosphate, and in acid soils, lime as well so that the legumes can operate to their fullest capacity in their rôle of taking nitrogen from the air and fixing it in the soil and of adding organic matter either as green manure crops or merely by the increased root growth.

With the establishment of such a system of nitrogen and organic matter (humus) supply to the soil, there need be no concern that India will not be able to make effective use of the artificial nitrogenous fertilizers, large scale manufacture of which is now contemplated. The high fertility building effects of ammonium phosphate, when used in conjunction with legumes in rotations in these experiments, is an assurance of this. India requires all the nitrogen she can get from whatever source. Combined with the use of phosphate and legumes, smaller quantities will be required to produce big effects which will enable the limited supplies of artificial nitrogen to go further. The continuous application of artificial nitrogenous fertilizers used alone to stimulate cereal crop yield may eventually bring about effects in the soils inimical to crop yield. Good cultivators however respect their soil and quickly appreciate the difference between soil fertility building practices and the artificial stimulation of crops by the supply of the one main element, viz. nitrogen. Now that both processes can be demonstrated it is for research workers to see how the best use can be made of the combined effects of both methods to secure a steadily rising plane of soil fertility and increased level of crop yield at economic rates.

LANDSCAPING OF HOMES

By BIRSINGH BHANDALL

LANDSCAPE gardening is a very fascinating and interesting subject. As a profession its recreational and educational advantages are many. A healthy, happy, and beautiful natural surrounding for the children is of such great value that its importance cannot be exaggerated. It inspires and satisfies the aesthetic taste and sense of beauty of an individual. It also stimulates a sense of creation. It provides vast opportunities for artistic composition and design and offers to the artist a limitless field for the expression of his emotions and feelings.

Landscape gardening defined

What is landscape gardening? It is the beautification of a tract of land having a house or other object of interest on it. It is done with a view to create a natural scene by the planting of lawns, trees and shrubs. The artistic and scientific laying out of grounds, knowledge of soil, its grading, handling of plants, and growing of a lawn, are some of the most essential operations which are necessary to develop a landscape. The information about plants in connection with age, size, shape, colours of flowers and foliage, is very necessary for the gardener. Without it he would not be able to make an intelligent use of plants in landscaping. Protection of plants from insects and diseases is also the gardeners' concern. A very wide field is covered in landscape gardening. It is in fact both an art and science of the establishment of a ground in such a way that there shall be a natural landscape effect.

Accessories to landscape gardening

Grading of land, seeding, and planting are incidental and supplementary to the one central idea of landscaping. It is to create a natural scene. The lawn is the canvass of the landscape picture. Foundation, planting and prominent central figure in landscape such as the house, make the framework of the picture. The shrubbery and flowers, along with other accessories, add colours to the landscape.

In making a picture of landscape, the second object is to avoid artificiality. To have a natural effect the picture must be simple and nature-like. Flowers are ornaments and mere incidents. They add emphasis, supply colour, give variety and finish. Even carpet beds give masses of colours only, not pictures. Various accessories and the flowers are to heighten and accelerate the landscape effect. They should never contradict it. To serve this purpose flowers must have a proper place to have a proper effect. They at such places can be grown freely and abundantly to give mass effect, which has a higher value because it presents a much greater range of variety of forms, colours, shades and texture. Proper grouping of flowers is done for desired colour effect

Nature abhors barrenness. So when a land is left to itself, sooner or later, a plant grows. This single plant in its natural environments gives the land a beautiful landscape effect, better than an elaborate planting in its unnatural place. The value of the plant may be in foliage and form rather than in bloom. In planting more depends upon the position that plant occupies with reference to each other and to the structural design of the place rather than on the intrinsic merits of the plant.

Primary considerations

One of the essential consideration in landscape gardening is that the place should be conceived as a unit. Looking around from a central point, every view should leave an impression of a certain definite picture. This impres-

Birsingh Bhandall is Panel Secretary, Ministry of Industries and Civil Supplies, Government of India, New Delhi.

sion should further make a homogenous part of the complete landscape. It should be in harmony with the other parts of the larger whole. The parts should never confuse and contradict each other. This does not mean to exclude the use of contrast as an effective means of bringing out the beauties of other parts. Some colours in flowers may not be as beautiful. But in contrast, the same colour in its juxtaposition with another proper colour, may look exquisite. Even beautiful colours appear more beautiful in the presence of another contrasting colour, for instance, the deep yellow flower may be beautiful but this in its juxtaposition with red flower might become exquisite.

The second consideration that one should keep in mind, is that there should be one central and emphatic point in a picture, such as the house or the pool. This central picture should dominate the landscape. The rest of the landscape should serve the purpose of complementing and supplementing the beauties of a central interest.

The landscape should have a open centre. This principle should be observed with a rare exception. The open apace should be lawned with a thick, suitable, and proper lawn grass. The flower beds in the centre of the lawn should be avoided. The pond with a fountain in the centre sometimes make a very attractive central feature of the landscape. The sides and the borders of the place should be framed and massed with shrubs and flowers. The overcrowding of flowers is to be avoided. Riots of colours, without forms and border, have a very bad effect on the picture. Scattered effect of plantings is very undesirable. It does not produce clarity and effectiveness of the picture, which is the primary object of landscaping.

Planning essential

All these fundamentals of landscaping should be kept in mind while the necessary operations are carried through. A plan for this purpose is necessary. No discussion on planning is adequate unless it is illustrated by the sketches and drawings of the various designs. These, however, are left out here for the sake of brevity. For the same reason no attempt is made to go into details. Only most important points of these operations are discussed here.

In order of procedure, the essential operations are planning, building according to plan, grading, fencing and establishing a lawn, planting trees, shrubs and flowers according to plan, maintaining the development by repeated painting and repairing of buildings, moving, cultivating, pruning and replacement in plant material. The plan is the most important of all these. It need not be elaborate and complicated. The simple plan is easy to work and is more effective for a landscape effect. A provision for the replacement of the plantings should be made because the plants grow in size from year to year. This change is necessary for the nature-like picture of the place.

Location of the building

The site and location of the buildings, is a very important factor which influence the determination of a type of a plan. Careful planning is necessary for locating the buildings for convenience and service. The effective drainage and the sanitation should be the guiding principle for determining the location. The water supply, bath and toilet rooms should be properly located in relation to kitchen, sleeping and living rooms. The direction of winds should be kept in mind in locating cattle-barn and other such things in the vicinity of a house. Where slope is too setep, the soil-erosion should be controlled by terracing, proper grading and sodding. For a fresh air, and maximum sun light, the facing of the house, its doors and windows, is very important. This should be planned in accordance with seasonal changes.

Drives

Drives in landscaping are blemishes. They, however, are very necessary

because of their utilitarian value. They should be direct, easily acessible, with convenient turns, and of proper width. Straight, curved, semi-circle drives have their own respective advantages. Each one of these suits a particular type of landscape. In a small place straight drives would be better, while in a larger place semicircular drives are better suited. The latter can come clear to the front door. Its both ends can serve as 'in' and 'out' gate for the traffic. A house on a hill should have a gradual convenient approach.

Arranging the public area

In landscaping a home three major areas should be properly planned. The public area should be arranged to serve the purpose of displaying attractively the home to the passer-by. It should increase his pleasure by making home a more beautiful picture. This can be accomplished more effectively when the public area is a considerable expanse of smooth, unbroken lawn bordered by shrubs and trees planted in irregular groups. An appropriate foundation planting around the base of a house completes the setting of the home for the public view.

The service area

The service area should be screened from the public and private area by plantings. It should be located in a place convenient to the kitchen and drive ways because it is there the objects of domestic needs are placed. The convenience and its usefulness can be greatly increased by making it compact and well-planned.

Screening the private area

The private area, in fact, is the outdoor living room. This part of the ground should be connected with the living side of the house. It should be screened from the pubilc view in order to secure privacy. The enclosures can be made with informal shrub groups or formal hedges. Formal hedges should be used in a small area, while in a larger place informal shrub groups would serve the purpose better and more effectively. A careful planning of the outdoor living room is necessary to increase its usefulness. It becomes more enjoyable by the proper planting of shade trees, flowers, and by locating properly the pool, arbor, and the lawn furniture. These are the essential features of the outdoor living room which should be carefully planned.

Selecting plants in relation to environment

The use of plant key for a model plan is necessary for the proper use of trees, shrubs and flowering plants. This would make the selection of plants for landscape easier. These plant keys vary with the geographical areas. The selection of native plants or those which can easily adopt themselves to new environments is desirable. Plants which cannot be well-grown in their new environments, with relatively less cost and ease, should be avoided.

Digging a pool

A pool in landscaping is another essential feature which can be used effectively to beautify the landscape. It may be rectangular, square, or circular. For a concrete basin required for certain garden and lawn conditions, the pool may take an informal shape resembling the natural pond. Its depth should be about two and a half feet, with about a foot-deep good soil and with sufficient depth of water for the plant growth. Formal pools should be walled or hedged. It, however, should not be hidden by plants in front of it. An open space, where it can have abundance of sunshine during the day, should be selected. Plenty of open water surface with a plant here and there gives the pool a more natural effect. The rim of the formal pool should be low. The lawn at places should come close to the pool, and should be at the same level with the top of the rim.

Hints for the amateur gardener

Each home presents a different problem in landscaping because of the individual preference of the owner. The following additional hints can be of great help.

The foundation planting should not hide the attractive features of the building. It should soften the hard lines. The lawn at places should come close to the building. It gives the effect that the building rests on the ground, not hangs on the foundation planting. It ties the building to the ground, which gives it a sense of stability and permanence.

Plant shrubs always in groups. A large variety of plants is not desirable. They are likely to cause confusion. Few plant groups serve the purpose better. They give variation in foliage or bloom throughout the year. Plants of equal vigour should be used in groups so that they may be able to compete with each other successfully. In mixed planting of evergreen and deciduous plants, the former should be near the entrance to add refinement. The ascending plants cause confusion in the picture by their abundant and irregular growth. Their use should be made sparingly.

When planting near the foundation, one should make allowances for the plant growth. Straight lines in plantings should be avoided. The front lines of the shrubs should have smooth curves. Generally the replacement of the base plantings after eight to twelve years becomes necessary for an effective landscape.

Planting of trees in landscape has a double purpose. It is used for the landscpae effect. It also is used for the purpose of having shade and frui' trees. This double purpose should a' ways be kept in view, and all possibilities of combination of trees should be explored.

Formal gardens in landscaping can be designed to give pictures of definite shape. Radial and rectangular gardens are so designed and named. Some gardens are named after the material used. The rock garden is one of them. It is made by the accumulation of rocks on which grow certain plants. It gives an impression of a mountain. The continuous flow of a little water down hill would make it complete and effective.

Gardening, a pleasant hobby

These all essentials of landscaping pointed out above, if followed closely, would help an amateur to do away with an expensive expert advice needed to create a beautiful landscape. Gardening should become the hobby of every man. Only a small tract of land around the home is needed. The start can be made with growing annuals. Man's fancy to create and grow things should be awakened. We love flowers. We should also learn to love them in their natural surroundings for the beauties of their colours in the landscape. For the same reason we should love the plants also. Our affection for plants as well as for flowers should encourage the development of landscaping in India. It is very essential in a growing society because it contributes to the greater measure of happiness of each individual. It can provide recreational and educational opportunities, both for the children as well as for the adults. This is very essential for the healthy growth of a community. Landscape gardening, therefore, is a worthy programme and a noble profession which we should seriously follow for the happiness of homes.

ROLE OF FISHERIES FOR THE IMPROVEMENT OF NUTRITION OF THE INDIAN PEOPLE

By SUNDER LAL HORA

THE main principle affirmed by the Famine Inquiry Commission in their final report (Delhi: 1945) is that the State should recognize its ultimate responsibility to provide food for all. 'Within the last 100 years, Governments in India have accepted the duty to prevent widespread deaths from famine, but the further obligation of taking every possible step not only to prevent starvation, but to improve nutrition and create a healthy and vigorous population, has not yet been fully recognized and accepted.'

Present state of nutrition

After surveying the food problem of India as a whole, the Commission have suggested the lines of a food policy not only designed to prevent famine in future but to improve the diet of the people for a better standard of health. The Commission admit the existence of much ill-health, disease and mortality in India due to mal-nutrition. It is estimated that 30 per cent of the population in normal times does not get enough to eat, while the diet of a large proportion of the rest is unbalanced. Improvement of nutrition, therefore, must form an essential part of the public health programme in India. A well-balanced and satisfactory diet is, however, beyond the means of large sections of the people, and an improvement in the diet of the people cannot be achieved without a great increase in the production of protective foods and a simultaneous increase in the purchasing power of the people.

Fish, a readily available protective food

Milk, eggs, poultry, meat and fish are animal foods of high protective value. The Famine Inquiry Commission found that 'the average daily *per capita* consumption of milk in India has been variously estimated as 5.8 to 10 oz. though in most parts of India it is less than 4 oz. daily. To effect an increase in milk production, though highly desirable, is a long-range programme. The same is the position with regard to meat. No immediate increase in the meat supplies can be expected. In fact, due to the slaughter of a large number of cattle, goats and sheep to feed the Army, it will take sometime to replenish the stock. Efforts are being made to step up the production of eggs and poultry but this increase cannot offset the great demand for total protective foods. In view of these considerations, the Commission laid 'strong emphasis on an increased production of fish as a very important part of the programme for improving the diet of the population' and recommended:

> 'In India, where the *per capita* intake of meat and milk is small, fish has special importance as a supplement to ill-balanced cereal diets. The present supply of fish is totally inadequate; the development of fisheries is one of the most promising means of improving the diet of the people.'

The Commission were of the opinion that a great deal can be done immediately to increase the supply of fish and they recognized that 'an increased supply during the next few years is very desirable, in view of the present difficult food situation and the scarcity and high prices of protective foods generally.'

Fisheries and the Royal Commission on Agriculture in India

It is not the first time that such strong emphasis has been laid on the development of fisheries in India. The Royal Commission on Agriculture in India

Sunder Lal Hora, D.Sc., F.R.S.E., F.Z.S., F.R.A.S.B., F.N.I., is Director of Fisheries, Bengal.

(p. 485, 1928), in commnting on 'Fish as an article of diet' observed:

'We have been struck with the comparative failure to develop the fisheries of the country as a source of food. We are aware that, in certain parts of the country, there are religious objections to the use of fish as an article of diet. But in Madras and Bengal, it is readily taken and much relished by some four-fifths of the total population. In Burma, it is universally liked and in the form of a fish paste (ngapi) is regarded as an indispensable condition. In Bombay, the United Provinces and Bihar and Orissa, large classes of the population take it when they can get it and, in the Punjab, there has been, since the war, a largely increased demand for it. Fish forms a specially valuable addition to a diet the staple of which is rice.'

After making various recommendations and pointing out that the development of inland fisheries should be regarded as one of the most urgent measures of rural amelioration, the Royal Commission on Agriculture in India concluded:

'Improvement in the cultivator's diet holds out such promise of improvement in his general health and the addition of fish to his diet impresses us as being so much the most promising way of providing it over large areas of the country, that we consider that we are more than justified in making recommendations which, to those who know the difficulties, may well appear to err somewhat on the side of optimism.'

The above recommendation of the Royal Commission with regard to the development of fisheries as early as 1928 seems to have had no effect on the authorities concerned till the Bengal Famine of 1943 brought once again to light the precipice on which the Indian people stand so far as nutrition is concerned.

Estimate of fish requirements

It will thus be seen that there is an urgent necessity of developing the much-neglected fishery resources of India in order to attain a better standard of nutrition and health. Calculating on the basis of 100 grams of dry protein per head per day, of which 50 grams should be first class protein of animal origin (milk, eggs, mat, popltry or fish), it is calculated by nutritional experts that proportionately 23 seers (one seer = approx. 2 lb.) of fish is needed by a person per annum. Against this individual requirement, and taking into consideration the huge population of India, the present marketable production of two crore maunds of fish seems extremely insiginficant. The Government of India have fixed a target of increased production at 300 per cent though according to the needs and requirements of the people it should be about 10 to 12 times more than the present production.

Role of marine and inland fisheries

Though India is rich both in its marine as well as in its inland fisheries, the latter are of greater importance in feeding the poor. Under the existing conditions, marine fish are distributed in a fresh state within a distance of 20 to 30 miles, while the bulk of the catches are cured and dried for export as the product is of an inferior quality. In the development of Indian fisheries, therefore, it should always be borne in mind that India's millions live far away from the sea. India has vast inland fishery resources, the climate is tropical, the people are illiterate and ignorant, the general standard of living is low and the means of communication are extremely poor. Under these circumstancs, a rapid extension of freshwater carp culture is the most hopeful way of tackling the urgent problem of increased fish supplies. In the proper utilization of the village pond, therefore, we find ideal conditions for the feeding of the poor with a nutritive diet and for raising his standard of living; the two objectives which the Famine Inquiry Commission have suggested should be the food policy of the Government of India.

BUILDING UP OF DISEASE-FREE STOCKS OF SEED POTATOES

By R. SAHAI VASUDEVA

POTATO is the most extensively cultivated of all vegetables in India. It is produced abundantly in other countries and its production exceeds that of wheat and rice combined. The area under potatoes in India is much smaller in comparison to other countries and is estimated at less than one per cent of the world acreage. The quantity produced in this country is highly insufficient as India was importing before the war potatoes worth about thirty lakhs of rupees from other countries so much so that certain parts were almost wholly dependent on foreign potatoes. The war resulted in complete closing down of what were previously large importations of seed potatoes from foreign countries. We had to meet an ever-increasing demand of seed potatoes from India and had even to find new sources of material.

A regular flow of potatoes for table purposes cannot be kept up without a constant source of seed potatoes of high quality and some system of maintaining freedom from disease on a large scale so that deterioration does not exceed the rate at which healthy material can be distributed.

On an average about 109 maunds of potatoes per acre are produced in India as against 224 maunds in Belgium and 183 maunds in the United Kingdom. Comparing with the other important potato-growing countries of the world the yield per acre in India stands at the bottom.

The poor yield in India is mainly due to the poor quality of seed. It has been observed by the farmers who have for generations been cultivating this crop that the stocks of potatoes always deteriorate when continuously grown in their land for several years and that change of the seed stock is necessary because it always yields vigorous crop. This knowledge of changing the seed stock is based on the fact that the farmers obtain greater produce from fresh seed than that from old stocks. A large number of cultivators are still ignorant about the real cause of the degeneration of seed potatoes and believe that change of seed is the only solution for all potato maladies.

Virus diseases as cause of deterioration

It has been determined in India as in other countries that the degeneration of seed potatoes is not due to environmental conditions but is caused chiefly by certain group of maladies known as virus diseases. These diseases are prevalent wherever potatoes are cultivated and cause huge losses in yield every year. So far the cultivators in India are unaware of these diseases though in progressive countries knowledge of virus diseases has spread among the potato-growers and they are taking necessary precautions to keep them under control.

In England the annual loss due to virus diseases is more than 66 thousand bushels while in 1926-27 in the United States of America the losses were 8 to 14 million bushels. In India so far no estimate has been made of the losses due to virus diseases but survey of these diseases in the hills and plains of India has clearly shown that majority of the plants are infected with virus diseases and in certain fields infection to the extent of 100 per cent has been observed. The infected seed material is used year after year and the disease in the crop goes on multiplying. Once a plant gets infected it is difficult to eradicate the disease. The produce of such plants will give diseased tubers which if planted again will result in diseased crop. Un-

R. Sahai Vasudeva is Assistant Plant Pathologist in the Division of Mycology and Plant Pathology, I.A.R.I., New Delhi.

less rigid methods are adopted for checking these diseases the chances of improving the yield of this crop are remote.

How virus diseases are spread

The chief virus diseases affecting the potato crop in India are mosaic, leaf-roll and streak. These diseases are spread from plant to plant in the field mainly by sucking type of insects, i.e. aphids. These insects while feeding on diseased plants pick up the virus and inject it into the plants which may be healthy. Tubers from such infected plants get the disease and when planted next season will produce diseased crop.

The spread of a virus within the crop is governed by several factors, the chief of which are the climatic and environmental conditions prevailing at the time. The initial factors are the number of alate aphids which arrive from outside sources and the degree of mobility within the crop. The date of maximum infestation of aphids is also important. The movement of alate aphids is controlled largely by weather conditions. High temperature, low humidity, and low wind velocity tend to favour the movement of the insects within a field while conditions of high humidity, low temperature and high wind velocity have an adverse effect on their movement.

Another factor to be taken into consideration is that the aphids hibernate on *Brassicas* and that the presence of these plants in the neighbourhood of potato crop means ultimately greater chances of spread of the infection in the crop.

Remedy: production of virus-free seed

As the virus diseases affecting potatoes are tuber perpetuated, the only practicable method of combating these diseases is the production of disease-free seed. The use of such seed will increase to an appreciable extent the yield of potatoes per acre and thereby enhance the total quantity of available food supply in the country. The question of supplying disease-free potato seed has, therefore, an important bearing on the 'grow more food' campaign.

The Indian Council of Agricultural Research have sanctioned a scheme for the production and multiplication of disease-free potato seeds which can be certified as such. The purposes of seed certification are two-fold: to see that the tubers are true to variety, and to see that they are free from disease. The latter is by far the more important of the two.

The first stage in the production of certified seed potatoes is the building up of virus-free nucleus of standard potato varieties. It is of prime importance that the variety under test is pure and true to type. In the first instance selection of apparently healthy plants is made in the field. Plants showing vigorous growth and promise of health, called units, are selected and lifted early so as to avoid the period of maximum aphid infestation. The tubers of these units are grown in the insect-proof house and the plants are kept constantly under observation for visible symptoms. As soon as a plant raised from a tuber of one particular unit shows infection, the whole unit is discarded. By this process of elimination only best plants are maintained for further tests. Freedom of these plants from virus infection is finally tested by mechanical inoculation on differential hosts. Grafting to certain hosts is also carried out, if considered necessary. Certain potato plants may carry a virus without exhibiting visible symptoms and such plants require careful testing for freedom from virus infection. All the tubers which pass these tests successfully are declared possible virus-free tubers and they would form hte 'virus-free nucleus.' In the case of a large number of units, tuber-indexing is a convenient method of selecting virus-free tubers but this method is at times unreliable probably because of the fact that some viruses are slow in coming up.

The possible virus-free nucleus is multiplied, examined and tested in the insect-proof house for two seasons be-

fore transferring it to the field. Plants which prove to be disease-free throughout these tests are finally selected and form the basis of virus-free foundation.

The next step is to multiply the so-called virus-free foundation stock. Production and maintenance of healthy seed potatoes is only possible if virus diseases are controlled. In this connection sound knowledge of virus diseases and their modes of spread in the field is most essential. As already mentioned most of these diseases are transmitted by insect vectors chiefly aphids. It naturally follows that good seed potatoes can be produced and maintained in healthy condition only in those areas where conditions for multiplication and movement of aphids are unsuitable. Health of seed potatoes is bound to suffer in localities where the incidents of aphids is high.

Survey of potato-growing areas in Northern India has shown that certain localities in the higher hills are suitable for the multiplication of disease-free seed potatoes, as the aphid population in such localities is appreciably low and the conditions for the movement of these insects appear to be unfavourable. In the multiplication of the virus-free foundation stock great care should be taken to ensure complete isolation from the cultivators' crop in the area which would serve as the source of infection. It would be desirable to have a non-potato belt around the multiplication plots. A border of some cereal crop which would not harbour insect vectors, should be uesful in providing further isolation. Another point of importance is the removal of foci of infection by clean cultivation and elimination of wild susceptible Solanaceae and other weeds that might serve as alternate hosts. The elimination of weeds is considered essential to the production of healthy seed potatoes destined for certification. The potato crop in these multiplication plots has to be carefully and constantly kept under observation. Any plants showing even doubtful symptoms must be immediately rogued out.

When sufficient stock of foundation seed potatoes is available it has again to be multiplied at the intermediate station in the lower hills before it is finally brought down to the plains. As the harvesting season in the higher hills and sowing season in the plains almost coincide, it is necessary that the disease-free material reaches the plains *via* the lower hills in order to provide sufficient resting period to the seed potatoes before planting in the plains.

In the plains work of multiplication of the disease-free material has to be carried out by progressive growers in localities, where spread of virus diseases has been found to be minimum, under the supervision of the technical staff. During multiplication the growing crop has to be regularly examined and careful elimination of diseased plants rigidly practised.

The stocks so produced would always be far superior to the ordinary commercial stocks and would provide with an excellent material for building up of sound potato industry in the country.

At the present moment we need to supply India with more seed potatoes. Because we have no system of certification we are in a position only to supply worse seed. Potatoes in the chief potato-growing areas are full of virus disseases. We cannot hope to control them without adopting a system which has been successfully practised in Europe and America for over thirty years. From the experience of other countries it can surely be predicted that if our new varieties produced after so much labour and expense are simply released at random into the potato districts of India, they will have a brief future. They will simply deteriorate in a few years into the same old disease-riddled mixtures of types that we already see wherever we care to look. If India wishes to see a prosperous potato industry based on sound foundations it must start the certification machinery working now on a large scale to provide reservoirs of healthy seed true to type which will serve to supply the potato-growing districts with enough certified seed for its purposes.

THICKNESS OF THE THORAX OF THE INDIAN HONEYBEE *APIS INDICA* F.[1]

By KHAN A. RAHMAN & SARDAR SINGH

THE queen excluder is an important applience in modern bee-keeping. It helps in confining the queen to a part of the hive for breeding queens under the supersediary impulse or for preventing it from scattering the brood all over the hive. The principle of the queen excluder is also made use of in the manufacture of the wire entrance guard which prevents the queen from leaving the colony during swarming and absconding.

Queen excluders

Two kinds of queen excluders are available in India, viz. the perforated zinc sheet and the wire queen excluders. Both are made on the principle that the size of the perforations or the distance between the wires should be big enough for the worker bee to pass through easily, but it should not be so big as to allow the queen bee to escape. The American and English types of queen excluders and wire entrance guards are made for the Italian bee—*Apis mellifica* L., which is a bigger bee than *Apis indica* F. and as such the latter's queen often escapes through their perforations. Therefore, it was decided to find the suitable aperture width for the three castes of *Apis indica* bees and in consequence the work on the thickness of their thoraces[2] was taken up in 1943. The results are presented in this paper.

Thorax-meter[2]

Betts[3] (1935) has described a laboratory thorax-meter, but due to insufficient details we could not reconstruct it. We devised a simple thorax-meter with which measurements up to $1/16 \times 1/8 = 1/128$ part of an inch or about ·008 inch could be taken. This thorax-meter consists of a wooden box (3 in. $\times$ 3 in. $\times \frac{1}{2}$ in. high with an opening (6/8 in. $\times$ 3/8 in.) in the top piece for placing the arms of a 'Columbus' beam-calipers. The inside of the box is blackened to compel the imprisoned bees to come to the only source of light, viz. the opening in the top piece. The 'Columbus' beam-calipers is calibrated in inches upto 1/16 in. and provided with a Vernier device which measures up to 1/8th of each 1/6 in. part.

Method of measurement

From each colony ten worker bees were caught at the hive entrance and put in the box through the opening in top piece. The arms of the calipers fixed at a known distance were then placed at the opening and the bees allowed to fly out. The time taken by each bee to pass through the fixed arms of the caliper was also recorded. Three bees could come out at a time in a row through the length of this aperture. Next distance was fixed after ten minutes and bees again allowed to escape. Drones were treated in the same fashion. Similarly a queen was imprisoned in the box and the distance between the arms of the calipers was varied until the opening was big enough for the queen to escape. Since the surface of the calipers was smooth, additional foot hold was provided by holding a piece of rough paper along the arms.

The worker and drone bees returned to their hives on their escape from the thorax-meter. Observations on queens

[1] Read at the 31st Session of the Indian Science Congress, Delhi, 1944.
[2] Thorax of the honey-bee is the thickest part of its body.
[3] *Bee World*, XVI (12) p. 141-43.

Khan A. Rahman is Entomologist to the Government, Punjab, and Sardar Singh is on the Staff of the Entomological Laboratories, Punjab Agricultural College, Lyallpur.

were carried out in a closed room with light from a window so that when a queen escaped from the box, it was caught and returned to the hive. Such queens had to be reintroduced into their colonies in the Smith introducing cages to avoid supercedure.

In all 265 worker bees from 25, 156 drone bees from 13 and 15 queens from 15 different colonies were measured at the Government Bee-farm, Nagrota (District Kangra) and the data obtained are given in Tables I, II and III, below:

Table I

Range in the thickness of the thoraces of the worker bees of the Indian honeybee Apis indica F.

Colony No.	Total No. of bees put in the box	No. of bees which 125 in.	escaped when ·133 in.	the opening was .141 in.
1	12	...	6	6
2	7	...	7	...
3	11	...	3	8
4	12	...	6	6
5	10	...	8	2
6	11	...	2	9
8	11	...	1	10
9	11	...	4	7
11	11	...	8	3
12	11	...	2	9
13	12	...	3	9
14	11	...	8	3
15	10	...	8	2
17	11	...	2	9
18	8	...	1	7
20	11	...	6	5
21	10	...	4	7
22	10	...	3	7
24	11	...	6	5
27	11	...	8	3
30	11	...	4	7
31	10	...	6	4
36	13	...	...	13
37	8	...	3	5
40	10	...	5	5
Total	265		114	151
Per cent			43	57

Table II

Range in the thickness of the thoraces of the drone bees of the Indian honeybee Apis indica F.

Colony No.	Total No. of bees put in the box	Number .156 in.	of bees .164 in.	which .172 in.	escaped .180 in.	when the .1875 in.	opening was .195 in.
3	12	...	...	1	5	5	1
6	11	...	1	5	4	1	...
12	11	...	...	5	3	6	1
15	12	...	...	8	2	1	1
22	12	...	3	6	...	3	...
23	11	...	...	6	1	3	1
24	12	...	2	6	2	2	...
26	12	...	6	2	2	2	...
27	12	...	1	6	5	...	...
28	11	...	...	6	2	3	...
29	12	...	...	8	4	...	...
38	12	...	...	5	5	2	...
46	16	...	...	7	3	6	...
Total	156		13	67	38	34	4
Per cent	...		8·33	42.95	24.36	21.80	2.56

TABLE III

Range in the thickness of the thoraces of the queen bees of the Indian honeybee Apis indica *F.*

Colony No.	Size of opening through which escaped	Total time minutes	taken seconds	No. of efforts made	Remarks
...	.156 in.	...	...	...	No queen could get through.
27	.164 in.	13	...	11	,, ,, ,,
1	.172 in.	2	35	3	Tried her best for 6 minutes. to escape through the .164 in. opening.
3	.172 in.	Straight	through	2 trials	In the previous opening .164 in. thrice tried to escape but failed.
5	172. in.	3	...	2	Tried to escape in the previous opening .164 in. for 13 minutes and made 10 attempts.
6	.172 in.	8	...	5	Escaped after great efforts.
8	.172 in.	6	30	13	,, ,, ,,
25	·172 in.	Straight through		2 trials	,, ,, ,,
47	.172 in.	...	20	1	Could not escape ·164 in. opening in 9 attempts in 8 minutes.
9	.180 in.	...	30	1	Could not get out in 15 minutes with 23 attempts in .172 in. opening.
18	.180 in.	Straight through		1	Could not escape in 9 minutes with great many attempts in .172 in. opening.
20	.180 in.	2	...	5	,, ,, ,, ,,
21	.180 in.	1	40	3	Could not escape in 6 minutes with 13 attempts in .173 in. opening.
30	.180 in.	2	20	5	,, ,, ,, ,,
31	.180 in.	Straight through		1	Could not escape in ·172 in. opening after a long trial.
46	.180 in.	Straight through		1	Could not escape in .172 in. opening in 7 minutes with 20 attempts.

I. *Worker bees*: Out of the 265 bees measured, 114 (or 43 per cent) passed through the opening when it was fixed at ·133 in. width. Thus the thickness of their thoraces varied between ·126 in. and ·133 in. The remaining 57 per cent passed through the ·141 in. opening, the thickness of their thoraces varying from ·134 in. to ·141 in. It, therefore, follows that the thickness of the thorax of the living workers of the Indian bee varies between ·126 in. and ·141 in. (since no bee could escape through an opening measuring ·125 in.) and a queen excluder with this aperture width will be suitable for them.

Roots (1935)[4] and A. T. Root Co.[5] (1937) fix this distance at ·163 in. and from ·158 in. to ·164 in. respectively for the Italian bee—*Apis mellifica* Linn., while Kelly[6] (1937) says that though ·157 in. is too small for the workers of the Italian bee, ·158 in. to ·164 in. aperture width is suitable for them, but an aperture a little more than ·164 in. wide will also keep back the queens but will allow quick passage to the worker bees.

[4] *A. B. C. X. Y. Z. of Bee Culture*, Medina, Ohio, p. 234.
[5] *Gleanings in Bee Culture*, LXV, (7) p. 445.
[6] *Gleanings in Bee Culture*, LXV, (6) p. 389.

II. Drone bees: Cut of 165 drone bees measured 13 (or 8·33 per cent) escaped through an ·164 in.; 67 (or 42·95 per cent) through an ·172 inch; 38 (or 24·36 per cent) through an ·180 in.; 34 (or 21·80 per cent) through an ·1875 in.; and 4 (or 2·54 per cent) through an ·195 per cent wide opening. Thus the thickness of the thorax of the drone bee varied from ·157 in. to ·195 in.

III. *Queens bees* : Cut of the 15 queens measured one (or 6·7 per cent) escaped through an ·164 in.; seven (or 46·65 per cent) through an ·172 in. and seven (or 46·65 per cent) through an ·180 in. wide opening. Thus the thickness of the thoraces of the queen bees of *Apis indica* F. varied from ·157 in. to ·180 in.

Conclusions

The above data clearly show that the size of perforations in the zinc queen excluders or the distances between the wires of the wire queen excluders for *Apis indica* should in no ca.e b. less than ·126 in. and more than ·156 in. This is a good theoretical range but for easy passage of worker bees we suggest the aperture width to range from ·140 in. to ·156 in.

* No data on the thickness of the drones and queens of *Apis mellifica* are available to the writers.

SOME MANURIAL TRIALS IN THE UNITED PROVINCES WITH TOWN-COMPOST

By B. N. LAL

VERY little experimental data are available on the manurial value of own-compost under varied conditions of climate, soil and crops. Two trials with wheat and barley were conducted by me in 1944 the results of which along with results of some trials on cultivators' lands near Pandharpur (Bombay Presidency) were reported by Dr Acharya in the Annual Report of the I.C.A.R. Compost Scheme, 1945 and in his Journal,[1,2]. Some more field experiments have since been conducted in the United Provinces on a comparison of town-compost with other types of manures and on the effect of different doses of town-compost on different crops. The second type of experiment was undertaken to determine the optimum does of this manure under conditions prevailing in the United Provinces. The results obtained during 1945 are summarized below:

TABLE I

Experiment No. I. Comparison of different types of compost and sulphate of ammonia on paddy

(Rice Research Station, Nagiun, 1945).

Lay out: 5 randomized blocks of 6 plots each.

Area of each plot: 1/73 acre.

Treatments: (1) No manure, (2) Maya Das[3] compost 50 lb. N. per acre, (3) Indore compost 50 lb. N., (4) Acharya's[4] farmyard compost 50 lb. N., (5) Town-compost 50 lb. N., and (6) Sulphate of ammonia 50 lb. N., per acre.

Agricultural operations: Variety—T. 21; sown by transplanting; sown in nursery 28.5.45; transplanted—5.7.45; manured—24.7.45; harvested—26.10.45; harvested area —1/92.1 acre.

Previous crop: Paddy-Fallow.

Summary of results

Treatments	Yield of rice in lb. per acre	per cent on mean
Sulphate of ammonia	1313.76	112.79
Acharya's farmyard compost*	1276.96	109.63
Town compost	1214.40	104.26
Maya Das compost	1179.44	101.26
Indore compost	1072.72	92.10
No manure	934.72	80.25
Mean	1164.72	100.00
S. E.	61.02	5.24
C. D.	180.13	15.46

Conclusion

Sulphate of ammonia>Acharya's farmyard compost>Town-compost>Maya Das compost>Indore compost>No manure.

1 lb. N in town compost gives 5·6 lb. extra yield of grain.

TABLE II

Experiment No. 2. *Effect of different doses of town-compost on paddy*

(Rice Research Station, Nagina, 1945.)

Lay out: 6 randomized blocks of 4 plots each.

Area of each plot: 1/59 acre.

Treatments: (1) No manure, (2) town-compost—50 lb. N. per acre, (3) town-compost—100 lb. N. per acre and (4) town-compost 150 lb. N. per acre.

B. N. Lal, M. Sc., Ph. D. (Lond.) is Biochemist, Compost Scheme, Department of Agriculture, United Provinces.

[1] Acharya, C. N. *Annual Report.* Scheme for preparation of compost manure from town-refuse in period ending 31st July 1945

[2] Acharya, C. N. Manurial value of town-compost manure, *Indian Farming*, Vol., VI, No. 9, 1945.

[3] Maya Das, C. and Das, N. K. An improved method of preparing leaf compost, *Indian Farming* Vol. VI No. 5, 1945.

[4] Acharya, C. N. Sectional Filling of trenches in farmyard manure preparation, *Indian Farming*, Vol., *VI*, No. 12, 1945.

Agricultural operations: Variety—T. 21; sown by transplanting; sown in nursery—28.5.45; transplanted—5.7.45; manured—24.7.45; harvested—25-26·10. 45; harvested area—1/78·3 acre.
Previous crop: Paddy—Fallow.

Summary of results

Treatments	Yield of rice in lb. per acre	per cent on mean
No manure	848.25	75.7
50 lb. N.	1020.51	91.0
100 lb. N.	1207.12	107.7
150 lb. N.	1406.79	125.5
Mean	1120.99	100.0
S. E,	84.56	60.5
C. D.	253.43	22.6

Conclusion: 150 lb. compost N. > 100 lb. compost N. > 50 lb. compost N. > No manure, 1 lb. N. results in 3·7 lb. extra yield of grain. There is an increase in yield with increasing levels of nitrogen.

Table III

Experiment No. 3. Effect of different doses of town-compost on wheat. (Government Agricultural Farm, Meerut, 1945).
Lay out: 6 randomized blocks of 4 plots each.
Area of each plot: 1/46 acre.
Treatments: (1) No manure, (2) town-compost—50 lb. N.; (3) town-compost—100 lb. N. and (4) town-compost—150 lb. N. per acre.
Variety: Punjab 591.

Summary of results

	Yield in lb. per acre No manure	50 lb. N	100 lb. N	150 lb. N
Grain	1613	1749	1925	2101
Straw	2345	2468	2752	2996

Conclusion

There is a porportionate increase in grain and straw yield with increasing dose of the manure.

1 lb. N. yields 3·2 lb. extra grain and 60 lb. of extra straw.

Table IV

Experiment No. 4. Comparison of effect of town-compost and farmyard manure on wheat
(Private Farm, Gonda, 1945.)
Name of cultivator: Mr. Abdul Haque, Gonda, 1945.
Treatments compared: (1) Farmyard manure—15 cart-loads (375 c. ft.) per acre.
(2) Town-compost—13 cart-loads (325 c. ft.) per acre.
Area of each plot: 1/3 acre for farmyard manure and 1/2·6 acre for compost (replicated twice)
Crop: Wheat (*desi* variety).
Date of sowing: Last week of October, 1945.
Date of harvesting: Last week of March, 1946.

Results

Treatments	Yield per acre Md.	Sr.	Ch.	lb.
Farmyard manure (375 c. ft.)	9	20	0	760
Town-compost (325 c. ft.)	13	10	0	1,060
Calculated yield with town-compost (375 c. ft.)	15	5	0	1,210

Conclusion

Town-compost manure is much more effective than an equal volume of farmyard manure.

The town-compost used in the above trials contained about 0.9 per cent nitrogen on the dry basis.

Acknowledgment

Our thanks are due to Mr. P. S. Gupta, Assistant Paddy Specialist, Rice Research Station, Nagina, for conducting the experiments on paddy and to the Farm Superintendent, Meerut, for conducting the experiment on wheat.

DEODORIZED SYRUP FROM *Gur* AND *Khandsari* MOLASSES

By J. G. SHRIKHANDE

DUE to the shortage of sugar in the country the ration of sugar has been most severely cut. The ration of 8 oz. sugar per head per month is hardly enough for any individual with an average standard of living. There is therefore a tendency for an average man to supplement his sugar ration with *gur*. *Gur* may be used as a sweetening agent for certain Indian sweets but its aroma militates against the aroma of tea or coffee. Secondly dealers in syrups, sharbats and aerated waters have been hardly hit by the shortage of sugar.

The typical *gur* odour or aroma is essentially due to the presence of an essential oil in addition to other volatile organic bodies produced in *gur* during storage due to the activity of certain micro-organisms and enzymes. On chemical considerations essential oils and the other volatile organic constituents like alcohol, acetone and low-boiling organic acids could be swept off by passing a current of steam through the *gur* syrup.

Accordingly a method of preparing deodorized syrup from *gur* and *khandsari* molasses has been developed at the Imperial Institute of Sugar Technology, Cawnpore. The process in brief consists of making a paste of *gur* in water of the consistency of a porridge and then drawing a current of steam through it for nearly two hours. By this time all the volatile bodies said above are swept off. The steamed syrup is then filtered through a layer of kaoline which absorbs any other impurities thus improving the colour and the odour of the syrup still further. The colour of the syrup is then finally improved by bubbling sulphur-dioxide through it. Final syrup is then obtained by concentration in basins or under reduced pressure.

By this process *gur* which has deteriorated during storage can be profitably utilized by converting it into deodorized syrup which may be used in tea or coffee, coloured aerated drinks and sharbats. The cost of production will be as follows:

Cost of production.

		Rs.	as.	p.
10 md. *gur* (deteriorated) of light colour at Rs. 5 per md.	=	50	0	0
Steam distillation and final concentration	=	5	0	0
Kaoline at 5 as per lb	=	2	8	0
Sulphur dioxide	=	5	0	0
Overhead charges	=	10	0	0
Syrup yield from 10 md. *gur* (8md. nearly)	=	72	8	0
Cost of 1 lb. of deodorized syrup nearly	=	0	1	9

J. G. Shrikhande is Head of the Organic Chemistry Department, Indian Institute of Sugar Technology, Cawnpore

What the Scientists are Doing

UREA AS A FEED DAIRY CATTLE*

THE value of urea as a substitute for protein in the ration of dairy cows was tried out in a large-scale experiment upon 274 cows at the National Institute for Research in Dairying, United Kingdom.

It was found that when a protein deficient diet was made good with a sufficient amount of protein, a significant increase in milk production followed, but when urea was used to make good the deficiency no significant change in milk production resulted. When urea was added to a normal protein ration, a net decline in yield occurred, but this was not to the extent of being statistically significant.

Everything considered, the work suggests that urea has a depressing effect on milk production when more than three ounces are given daily. Changes in butter fat yield and body-weights of a proportion of the cows reflected the same effects shown by milk yield. It was concluded that urea probably has a protein-sparing effect when the dietary protein is low and the urea dosage is low. However, when fed at levels of ingestion which would be necessary to justify its use economically, urea is a milk-yield depressant.

* Barttet, S.and Blaxter, K. L, (1947) The value of urea as a substitute for protein in the rations of dairy Cattle, *J..Agri.Sci.*, 37 (1)

You Ask We Answer

Enquiries regarding agriculture and animal husbandry should be addressed to the Directors of Agriculture and Veterinary Services in provinces and states. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. May I know what strides have been made in the research on artificial insemination in India?

A. Research on artificial insemination has been taken over as part of the normal duties of the Genetics Section of the Indian Veterinary Research Institute, Mukteswar. Special attention has been directed towards defining and overcoming practical difficulties in its application under Indian conditions. Attempts were made to popularize it in the villages around the Institute, and centres have been opened in Calcutta, Patna, Montgomery and Bangalore. Experiments at the Institute were continued on the preservation and transport of semen under tropical conditions. A container of a reasonable size which would keep semen at a low temperature for a long time enough to allow its transportation to any part of India is being constructed with the help of the Calcutta University. A private firm has, under the guidance of the Institute, produced a satisfactory set of appliances at a reasonable cost.

Only a few dilutors out of the large number tried by foreign workers have given satisfactory results. The following were used for both bull and buffalo semen: (i) egg yolk phosphate, (ii) egg yolk citrate and autoclaved whole milk; and in the case of ram semen (i) egg yolk phosphate and Winter's were tried. The necessary motility rating was preserved at 3 to 5 days, 3 to 5 days, 2 to 3 days respectively and in the undiluted bull semen 1 to 2 days. In case of ram semen it was 3 to 5 days in all dilutors as well as in the undiluted semen. Pregnancy has been produced in the cows with 1/9, in ewes with 1/20, with goats with 1/16 and in buffaloes with 1/11 of a single ejaculate. Fractions from 1/20 to 1/40 have been used in a large number of ewes. Pregnancy has been obtained in cows and buffaloes with up to 6 days preserved semen respectively and in ewes with 7 days preserved semen. The percentage pregnancy obtained in cows, ewes, and she-goats has been 79, 100 and 80 respectively, but in villages the percentages were 71, 75 and 63 and 48 in buffaloes.

(*Annual Report of the I.C.A.R.* 1945-46)

AGRICULTURAL ECONOMY OF THE APA TANIS*

By N. K. DAS

THE Apa Tanis are a hill tribe of the Balipara Frontier Tract about which little is generally known even by the people of Assam. Generally speaking, *Jhuming* or shifting cultivation is a predominant feature in the agricultural economy of the hill tribes of this province. But the agricultural economy of the Apa Tanis is not only an exception to the general rule, but is developed to a degree which is surprising.

Habits and habitats

The Apa Tanis' habitat is a single broad valley lying at an altitude of 5,000 ft. Steep mountains rising to 8,000 ft. ring this valley. It is drained by the Kale river. Before the advent of the Apa Tanis it may have been a meandering stream but today it is forced into a more or less straight course between high dams. The wide flat valley has been transformed into an enormous mosaic of carefully tended rice terraces, while in islands of higher ground lie groves of pines, bamboos and fruit trees and great villages with labyrinths of densely crowded streets.

It is estimated that a population of 20,000 Apa Tanis derive the bulk of their sustenance from the twenty odd square miles of cultivable land using the surrounding hills only as hunting grounds. There is probably no other example of an Asiatic hill tribe surviving, and indeed maintaining, a comparatively high standard of living in so restricted a territory. In many ways the Apa Tani stands on the cultural and economic level of neolithic man (though iron is of course in common use), but if one considers the perfection with which by no other economic methods than those of the later neolithic age he has established his mastery over nature, one begins to understand how many of the oriental high civilizations could have been evolved during epochs preceding the dawn of the metal age.

Inside an Apa Tanis village

To get a glimpse of an Apa Tani village one must visualize a village built on high ground, hundreds of pile-dwellings standing wall to wall in streets, clusters of granaries at safe distances from village fires, bamboo groves, kitchen gardens, high pines and fruit trees and rows of small terraces used for raising rice seedlings. Around the village are rice fields consisting of terraces following each other in uninterrupted succession till another village is reached. High level ground is used for the cultivation of dry crops, the bracken-covered hummocks as pasture land, but wherever there is water the Apa Tani will have harnessed it in his service. At the end of the valleys are to be seen curious fenced-in plots of luscious green which, although one would take them for pastures, are really kept for the cultivation of leafy plants from which a salty substance, the black 'Apa Tani salt' is extracted. The hill sides are covered with forest, plantations of pines and other useful trees in carefully nurtured plots. Several thousand feet above the valley is the untended forest.

*The article is based on a note prepared by Dr. C. V. F. Haimendrof, a Special Officer of the Governmern of India In preparing this note the very words of the original note have been freely used. Necessary permission has been obtained.

N. K. Das, is Assistant to the Director of Agriculture, Assam, Shillong.

The tribal land

It must have been clear from the above that land is very highly valued among the Apa Tanis. It is the main source of wealth and all other and less permanent possessions are mainly valued as a means of acquiring land. The tribal land of the Apa Tanis falls into three categories.

(1) Land owned by individuals.
(2) Clan land.
(3) Common village land.

The first category comprises of practically all cultivated land including the land under groves of bamboos, pines and other useful trees, as well as the sites for houses and granaries. Clan land consists of meadow land near the village used as pasture and burial grounds and tracts of forest, sometimes at a great distance from the village, where only the members of the owner clan can hunt and trap. Common village land is confined to one or two usually not extensive stretches of pasture, and to forests tracts on the periphery of the Apa Tani country.

The Apa Tanis measure most higher values, including land values, in *mithan* (*Bos frontalis*) which are virtually a currency. The value of a full grown *mithan* expressed in money is today between Rs. 100 and 300.

An average family of five or six members can meet its requirement of rice from the yield of approximately 1 to 2 acres of well-irrigated rice land having a yield of about 300 yagi, basket of unhusked rice. Poor men with little or no wet land have a chance of being able to grow at least part of their food supply by buying plots of dry land which are used mainly for the cultivation of millet and are comparatively much cheaper than wet rice land. In some places, it is possible, however, to transform dry land into terraces, and a poor man may thus acquire some wet land at comparatively low cost. But such terraces on high land produce less rice than those in the bed of the valley.

Another way of obtaining land suitable for rice cultivation is to lay out new terraces on common clan land (pastures in the bracken-covered hillocks). Only members of the owner clan do this. Once permanent cultivation is established the terraces become private property of the members who opened them. Similarly common pastures can sometimes be turned into fields for dry cultivation but this is often resisted by cattle owners.

The high price of irrigated land, the fact that it can be bought for cattle and *mithan* and the restricted area of the Apa Tani country have given rise to a capitalistic trend in the Apa Tani economics. The poor landless men have to work for others to earn a living. In recent years work in the plains of Assam has enabled many an Apa Tani to acquire cattle.

There are certain forces which counteract the tendency for land to accumulate in the hands of the rich men. The inheritance laws lead to the division of a man's land more or less equally among his sons, and many men divide up most of their land when their sons marry and set up their own households. A wealthy man is moreover expected to provide some land for his dependents. Slaves who have grown up in his house and shown themselves able and hard-working are usually allowed to set up their own households once they are married and have one or two children. Their master is then under an obligation to give them some land; it may not be much, and this cannot be reclaimed unless the freed slaves die without male issue. Again, protracted illness necessitating innumerable sacrifices of *mithan* and cows may compel a rich man to sell land.

While Apa Tanis will give land to dependents they never hire it out. A poor man must therefore either be content with the irregular income of daily wages or he must find, in a rich man's family, a position hardly different from that of a slave.

1. One Yagi basket contains approximately 6½ seers or 13 lb. of paddy.

Agricultural practices in Apa Tani village

Apa Tani agriculture is only in a restricted sense primitive in its methods, the plough never being used, but it is very intensive and gives evidence of great capacity for planning and concerted effort. Rice is the staple food and it is also the principal item in the Apa Tanis' export trade. Every one of the larger streams rising in the wooded heights that ring the Apa Tani country is tapped soon after it emerges from the forest and reaches the bed of a valley wide enough to accommodate a series of narrow terraces. Even the small springs are utilized for the purpose. The Apa Tanis do not make terraces that climb the mountain slopes for a thousand and more feet. Their genius has manifested itself more in a meticulous and expert care for every crop than in impressive feats of engineering. Disputes over water are rare and when they occur a settlement can usually be reached by the division of a channel.

The Apa Tanis are not content merely to maintain an established system of terraces and channels which to the casual observer looks little short of the perfect. If the yield of a field is not up to the standard the owner will carry out improvements before the sowing season. Tools used in earth work comprise the hoe (the type common in tea gardens) and flat wooden trays. The hoes are imported from the plains of Assam and although today they appear indispensable to the Apa Tani, old men still remember the wooden hoe-like implement used in their fathers' time.

Although the scope for opening new terraces appears limited, not a year passes without some small plots being turned into terraced fields. As these are necessarily opened on high land, rain water has to be relied upon for their cutlivation. Only early varieties of rice can be grown on such terraces.

There are two types of rice fields—those permanently kept under water or at least in a moist condition, and those that dry out and harden soon after harvest. In the former, the rice is perennial and the plants produce grain for two or three years—the stubbles remaining in the field after each harvest sprouting in the next season. Vacant spaces are filled up every year. The rice here is late ripening. There are three varieties of late ripening rice under cultivation. Earlier varieties are grown on land not allowed to remain perennially under water.

In case of all types of rice, seed grain is selected and separated from food grain while still on the fields. Thus a system of mass selection is in vogue.

As is natural in an intensive system of cultivation, the Apa Tanis expend a great amount of energy on manuring. Throughout the winter and spring months women and men are to be seen daily carrying baskets of rice chaff, pig and chicken droppings, ashes and kitchen refuse to heap on their fields. When the dried out terraces for the early rice are dug and cleaned, the stubble and rubbish are collected in heaps and burnt. The ashes are then spread over and worked into the soil. This process is also adopted in the case of the dry millet fields. Even cattle dung available in the pastures is collected and utilized. In addition manurial ingredients contained in the washings from the higher slopes help in maintaining the fertility of the soil.

The dry crops in the Apa Tani country are millet, maize and various vegetables. Many of these are grown in gardens and the methods employed in their cultivation are those of the horticulturist rather than of the ordinary peasant.

Transplantation of millet is probably unknown anywhere else. But the Apa Tanis transplant two varieties of *Eleusine coracana* like rice. These are grown on rice field bunds and in the open dry fields. The fact that even these bunds are made to grow some food is an evidence of the determination of the Apa Tani to make the best use of the land at his command. The cultivation operation for millet begins in May and the harvest is finished in November. It is used mainly for

making beer but is sometimes also crushed and made into rough kind of bread.

The dry crop next in importance to millet is maize of which three varieties are grown. The other garden crops of the Apa Tanis are beans, chillies, tobacco, marrow, cucumber, taro, ginger, potatoes, tomatoes and a coarse kind of spinach. Young bamboo shoots are used as food in large quantities during the months of March, April and May.

Although the weaving industry of the Apa Tanis is more highly developed than among any other tribe in the vicinity, they do not grow cotton, obviously on account of the necessity of growing food on the available land.

Raising and maintenance of bamboo groves, pines and fruit trees form an integral part of Apa Tani agriculture. Villages of up to a thousand houses would have difficulty in finding sufficient building material in nearby forests unless regeneration kept pace with fellings.

Pinus excelsa in the most characteristic tree of the Apa Tani country. The Apa Tanis hold that they brought it with them when they immigrated from the country north of the Kamla and Subansiri rivers. The tree grows to a height of 170 ft.

There are four distinct kinds of fruit trees grown by the Apa Tanis. These are (1) a small cherry, (2) a peach, (3) a small pear and (4) a greenish and rather bitter apple.

The well-stocked pine groves on the hill sides surrounding the Apa Tani Valley are a remarkable tribute to the Apa Tanis' skill in forestry. The trees are usually all of uniform age and the entire grove is fenced in to protect it against straying cattle.

Animal husbandry

In the very intensively cultivated country and densely populated villages of the Apa Tanis, there is not much scope for animal breeding. Still, it is believed that the number of *mithan* belonging to the Apa Tanis must be many thousands. Only a very few of these are to be seen in the Apa Tani Valley. *Mithan* prefer the shade of forests to the open pasture and roam singly or in small groups rather than in large herds. The only times when a *mithan* comes anywhere near his owner's house is possibly on the day of purchase and invariably on the day of slaughter. Prices of land, bride-prices, ransoms and fines are usually paid in *mithan* and while pigs are the sacrificial animals at most of the communal agricultural rites, *mithan* must be slaughtered at the rites performed and the feasts given by individuals who want to raise their prestige. Thus *mithan*, like land, constitute a measure of a man's wealth.

It is believed that the majority of the Apa Tanis owning *mithan* give their animals into the care of Dafla and Miri friends whose country is more suited to the rearing of cattle. In no case, however, is there any controlled breeding.

Less valuable than *mithan*, but used in the same manner for sacrifices, as a source of meat and as currency, but never milked, are cattle of the poor breed common in the plains of Assam. These are almost certainly derived from imported stock. In the Apa Tani country crosses between *mithan* and cattle are not in evidence as they are kept separate by their own habits and preferences for different grazing grounds.

A few Apa Tanis own goats which are always kept in the neighbouring Dafla country. They are too destructive to be kept in the Apa Tani country. Goats are used for private sacrifices and are never milked.

Pigs are in certain respects the favourite domestic animals. These are housed below the pile-borne dwellings in boarded up enclosures between the house-poles. Once a pig enters this enclosure it leaves it usually only on the day of slaughter. No pigs roam the village streets; for, if let loose they would do serious damage to crops. This sets a limit to their number and no household can afford more than

three or four full grown pigs at a time. The food given to pigs consists of the husks of grain, the dregs remaining from brewing of millet and rice beer, ordinary kitchen refuse, the sago-like pith of a certain forest tree, and also human excrement. The Apa Tanis relieve themselves on narrow verandahs that run alongside their houses, and the excrements, falling straight into the pig stye, are immediately devoured. Young pigs are generally purchased from Daflas and Miris and fattened. Breeding of pigs is done by few Apa Tanis. The pig is the ceremonial animal indispensable for all communal rites. Pork and bacon are more highly prized than any other meat, and sides of bacon are not only the most acceptable gifts between friends and kinsmen but are also a recognized currency for ceremonial payments.

Fowls are also reared. For the taking of omens and for innumerable minor sacrifices and offerings, chickens and eggs are needed. Required for so many vital purposes, these are therefore expensive. Two eggs count as a day's wages. A hen costs as much as a knife and a big cock as much as a short *dao* or a simple cloth.

The dogs are of the non-descript kind common in the plains of Assam. Although Apa Tanis eat dogs, few of them are slaughtered for the sake of their meat. They are sacrificial animals proper to certain rites. Although an Apa Tani does not treat his dog badly he expects his dog to fend for himself and does not give him a substantial meal.

In fields and gardens

Most of the work of fields and gardens is done by the husband and the wife and their children as well as any relative or slave who may be a member of the household. Although there is not always a clear division of labour between the husband and the wife the former is mainly responsible for such items of work as building and up-keep of dams, terraces, channels and fences, for the digging over of fields and planting of trees, the latter being mainly occupied with the care of nurseries and gardens, the transplanting of rice and millet and weeding of crops.

From childhood every Apa Tani boy or girl belongs to a labour gang (*patang*) and this associattion continues to some extent in later life. Thus a man who has to rebuild a rice terrace will ask some of his *patang* friends to help in the work and in turn he will work on their fields whenever his assistance may be required.

A *patang* works in turn on the fields of its members' parents without wages but a rich man may employ it out of his turn on payment. There are also many poor men and women who work on wages. The average rate of daily wages is just under two seers of husked rice. There is, of course, the reserve clan land where new terraces can still be carved from the hill sides, but the really poor who live from hand to mouth by daily labour, can seldom spare the time for the strenuous task of building new terraces. Thus co-operative and capitalistic trends exist side by side and neither of these shows at present any sign of eliminating the other. The man of modest means who cultivates his fields with the help of his family and the *patang* of his children is not in danger of being ousted by the owner of a hundred fields, nor have the poor very much chance of effecting a more equal distribution of the existing land.

BIHAR

By B. N. SARKAR

GENERALLY speaking, during the quarter ending 30 September, 1946, rains were sufficient and uniformly distributed in the major part of the province. It was slightly below normal in the districts of Chota Nagpur and in parts of Muzaffarpore and Saran. Abnormally severe floods were, however, experienced during the months of August and September with the result that *bhadai* and maize crops in the districts of Bhagalpur, Monghyr, Darbhanga, Muzaffarpore and Saran were badly affected. The September floods were too frequent and severe throughout the Tirhut Range and in parts of the Patna Range. These floods caused considerable damage to the *kharif* crops and at places where this was severe the entire crop was lost. The immediate problem arising out of this was the shortage of fodder and cry for supplying *rabi* seeds. Immediate action was taken by the Agricultural Department to procure as much of *rabi* seeds as possible for the flood-stricken areas with the result that about 55,000 md. of wheat and gram seeds were arranged over and above what the Department had stored for normal distribution.

Harvest

The harvesting of *bhadai* crops and the transplanting of *aghani* paddy was practically completed during the quarter. As reported in the preceding paragraph, the *kharif* and *bhadai* crops which were more or less normal during July and August, except at some places, suffered from severe floods during the latter half of the quarter. The condition of paddy crops was, on the whole, fair.

The rains helped the growth of the sugarcane crop although on account of the consequent lowering of temperature and increase in humidity, they also helped the incidence of top-borers in the crop. Reports of borer attack were prominent from low-lying or water-logged areas in Saran and Champran. The heavy September showers were also responsible for lodging of the crop. The Watch and Ward Service returns also indicated the incidence of Pyrilla in the broad-leaved cane Co. 419 at Motipore where conservation and release of indigenous egg-parasites served to keep the trouble in check. Tests with 2 per cent D.D.T. sprays on cane crop, 10 to 15 per cent of which was attacked by white fly at Bikramganj showed that about 26 per cent of the puparia could be destroyed by this means. *Trichogramma* release in colonized plots in Champaran and Muzaffarpore continued to give encouraging results in respect of stem and root borer control. The flowering parasite *Striga*, found throughout Saran was also noticed during the quarter in the reserved areas of Lauriya (Champaran) and an intensive survey conducted in Hathua (Saran) revealed its abundance in *Kodo* (*Paspalum scrobiculatum* Linn.)—typically infested fields manifesting a scorched look. In the earlier part of the season, red rot was noticed in Co. 331 in South Bihar and wilt in Co. 385 in Saran and Champaran.

Apart from the damages due to floods, the condition of all other standing crops remained fair.

Grow more food drive

The period under review was the slack season for minor irrigation works, comprising as it did of rainy months. The number of the projects completed during June 1946 was 190 and the pro-

B. N. Sarkar, O. B. E., is Director of Agriculture, Bihar, Patna

gress made during the quarter is summarized below:

(a) Number of schemes sanctioned during the quarter 471
(b) Number of schemes completed during the quarter 172
(c) Number of schemes under execution at the end of quarter 1098
(d) Estimated area benefited by (b) 23,827 acres
(e) Cost of completed scheme vide (b) Rs. 75,070

Under the Tube Well Water Supply Scheme, three 5 in. borings have been completed, three are in progress and two are about to be taken up in the Tirhut Range. A 15 in. boring for the Public Health Department of the Patna Circle is being executed by the Agricultural Engineer. A number of 2½ in. and 3 in. borings have also been completed and are in progress.

Distribution of seeds, manures, etc.

The figures for seeds, etc. distributed during the quarter through the agency of the Agricultural Department are given below:

Paddy and other *karif* cereals	15,888 md.
Vegetable seeds	3,262 lb.

The above figures do not include thousands of seedlings of vegetables and papayas, etc. and a large number of grafts of fruit plants distributed by the Department. Nearly 58,000 grafts of mangoes, guavas, lichis, citrus and other fruits obtained from Departmental farms and approved nurseries were supplied to the public during the quarter under review.

As a measure to induce every household in the villages to grow some fruits, free supply of seedlings of papaya is made by the Agricultural Department where kamdars take the plants with them on their tours and actually plant them in the kitchen gardens or compounds of cultivators. During the present season, about 5,00,000 seedlings of papayas and 15,000 plants of guavas (Allahabad and Safeda varieties) and *kagzi* lime have been distributed under this measure.

Under a scheme inaugurated in 1945 for increasing the production of fruits in the province, approximately 5,000 acres of existing orchards were attended to.

With a view to popularize poultry farming amongst cultivators and others in Chota Nagpur and to grade up the country birds 26 cocks and 45 hens of the White Leghorn breed were supplied by the Department at concession rates.

Contour ridging

Under the Contour Ridging Scheme, working in Purulia, terracing along suitable contours was conducted over 145 acres of waste land in village Bansahra including a total earth work of 1,32,440 c. ft. at a cost of Rs. 1,560. The bundhs and ridges were turfed in the rainy season to check surface erosion. As a result of the operations, 70 acres of land lying waste since years has again been brought under the plough.

General

To meet the great public demand for trained malis, two training centres have been opened, one at Patna and the other at Sabour. The first batch of 20 trained malis have come out in December 1946.

The Agricultural Marketing Section of the Department had varied activities duirng the quarter under report. The Senior Marketing Officer visited the Bombay Prsidency to study the work of the Bombay Weights and Measures Act. A bill for standardisation of weights in the province has been drafted and submitted to the Provincial Government. A number of other reports and information covering a variety of subjects such as the distribution of mustared seed and work on its pure line breeding, figures of production in respect of important agricultural commodities, e.g. rice, wheat, barley, tobacco, potatoes, etc.

Fig. 1—(Left) and
Fig. 2.—(Right).
Floods in North Bihar.

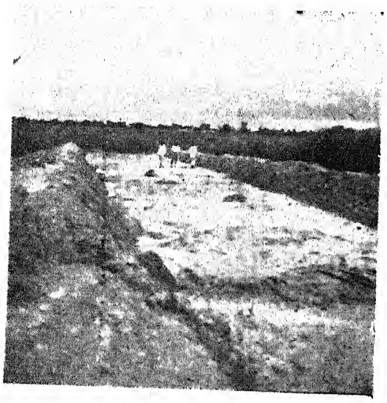

Fig. 3. (left) and
Fig. 4 (right).
Two drainage channels constructed by the Department of Agriculture Bihar in Muzaffarpore District.

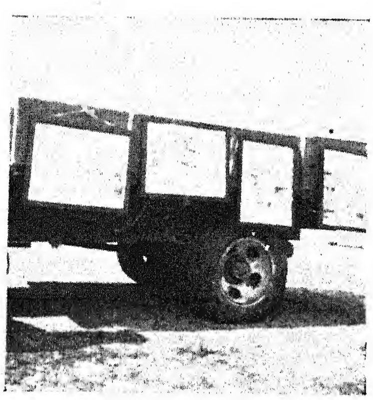

Fig. 5. (left) and
Fig 6. (right).
Motor trucks containing educative charts on display.

PLATE 66

information on the marketing of meat, mangoes and betelnuts, etc. were supplied to the Agricultural Marketing Adviser to the Government of India. The section also presented its final report on the smuggling of *ghee* outside Bihar and the methods recommended for adoption for checking the smuggling to the Provincial Government for their consideration.

The Sugarcane Specialist conducted detailed surveys and analyses of soil profiles in the districts of Purnea, Monghyr and Bhagalpur. Reconnaissance surveys were also conducted in the surface soils of the white sugar belt of the province. Experiments conducted with ammonium sulphate at the Central Sugarcane Research Station at Pusa indicated that this fertilizer decomposed to the extent of over 70 per cent in Pusa calcareous soils within a week of application but the decomposition was largely checked in 15 per cent or higher moisture-content. It was also found that out of the several organic manures in combination with which it was tried in calcareous soils, castor cake increased the retentive capacity of this fertilizer most. Experiments in *gur* storage showed that furnace ash was a definitely superior blanket for this storage as compared to the common *bhusa* blanket. Of the varieties of cane tested for their *gur*, *gur* of Co. 313 and 513 was found to possess better keeping quality.

CATTLE RELIEF WORK IN NOWGONG FLOOD

By V. R. GOPALAKRISHNAN

IN Nowgong district, a fairly extensive low-lying area known as Kapili Valley, was flooded during the month of October 1946. The rivers were in spate, the cultivated areas had gone under water and the villagers and their livestock were stranded. Incessant rains caused a steady rise in the flood inundating many villages and extending to further areas. Severe havoc was apprehended especially the destruction of homesteads, crop and cattle. So immediate and effective measures were taken by the Gvernment Departments and various relief organizations to cope with the situation. Coordinated and sustained efforts were made to render all possible help to the cultivators and to relieve misery.

Relief work

The Civil Veterinary Department took immediate steps to organize relief measures. All available staff of the Department that could be spared, were deputed to the flood-affected area and relief centres for cattle or cattle camps were opened in suitable localities. The staff worked in cooperation with the Nowgong Flood Relief Committee and were in consultation with the Flood Relief Officer in regard to the main plan of relief work.

The urgent task of rescuing and saving cattle from the flood-stricken areas was taken up first and several thousands of cattle were removed to safer places or to neighbouring relief centres. In certain localities cattle were standing or moving about all along in water, sometimes up to knee-deep water. Most of them were practically starving, exhausted due to exposure and also much reduced in condition. The relief measures were directed to reach worst affected areas and families. It was estimated that nearly one lac cattle had been affected by the flood in the whole area and about 40,000 cattle required immediate attention.

The main problem was feeding these cattle and to arrange for adequate fodder. This was very difficult as there was already scarcity of fodder in the flooded areas. The rescued cattle had, therefore, to be removed either to distant grazing places or to high lands including the Railway line and the Trunk road.

Besides, an urgent appeal was made soliciting help from all quarters to feed the dumb animals. Rice-mill owners all over Assam were requested to supply *Bhuchi*. Army authorities were approached for the supply of any suitable variety of cattle fodder at their disposal. With the available fodder, oilcake, etc. thus received, the animals in the various cattle camps were fed and maintained.

Disease control

It is usually observed that cattle diseases break out soon after the subsidence of floods and therefore due precautionary measures were taken to combat any epidemic. A few outbreak of rinderpest were noticed and they were dealt with promptly by serum inoculation or vaccination with goat tissue virus according to the nature of outbreak. For starved and emaciated cattle, serum inoculation was found preferable.

About three to four weeks after the floods, foot-and-mouth-disease broke out in a fairly widespread form. Medicinal treatment and other control measures were carried out and the disease subsided in due course.

A large number of animals suffered from water-sore. This condition was observed in cattle that were standing in the water for a long time. Swellings

Rao Sahib V. R. Gopalakrishnan, G. M. V. C. is Veterinary Investigation Officer, Assam, Gauhati.

in the legs and cracking of the skin were noticed. Therapeutic treatment was given to all the ailing cattle with satisfactory results.

Nearly 3,000 cattle were inoculated and over 2,000 cases were attended to in the cattle camps, in addition to the cases treated in the actually affected localities.

Year after year, certain low-lying and riverain tracts in Assam are flooded and sometimes with devastating effects. There is great scarcity of fodder in the flooded areas and the cattle population have to depend for their existence on what little vegetation they can find on the village high lands or on the slopes of hills. As a result, the working capacity of bullocks is reduced, the milk yield in cows is decreased and they also become predisposed to infection. A plan is now under consideration to overcome the havoc and misery caused by the periodic floods.

AN OUTSTANDING INDIGENOUS HILL COW

By MALIK FAZAL HOSAIN

THE indigenous cattle found round about the Kumaun Hills are small, weighing about 300 to 350 lb. and producing a very negligible amount of milk. Their lactation period seldom exceeds 150 days and the dry period is usually a long spell between the first calving to the next. The small stature and the low productivity in these animals are mainly due to the lack of feed and fodders, the quantitative insufficiency of which is accentuated by their doubtful qualitative character. The rigours of climate in the hill is another important unfavourable factor. Experiments conducted on improved methods of management and feeding have, however, revealed that for increasing the milk production there is scope for improvement of these hill animals. An instance of this improvement can be reported from the performance of Madhuri No. 49 belonging to the herd of hill cows kept at the Indian Veterinary Research Institute dairy in Mukteswar.

Madhuri was born on 19 December, 1938 in Mukteswar dairy to a sire and out of a dam both belonging to the Institute herd.

She first calved on 23 January, 1942, when she was three years old. The calf was weaned at birth. The following are details of her subsequent calving, milk yield, etc.

Date of calving	Date of drying	Lactation yield lb.	Lactation days	Days dry
23-1-42	21-9-42	753	241	169
9-3-43	9-8-43	662	153	252
17-4-44	30-10-44	804	196	161
9-4-45	7-1-46	927	273	106
23-4-46	...	...	...	...

From the data given above it is apparent that compared to an average type of hill cows, Madhuri's performance is outstanding, not only in total lactation yield, but also, in longer in-milk and short dry periods. She is also a regular calver. The animal is showing continued improvement in her productive performance.

Madhuri is now being used for cross breeding with an Afghan bull. It is hoped that the cross-bred progeny of such an outstanding dam will show a greater improvement in milk yield. Her cross-bred male calves are being raised for distribution to the Animal Husbandry Department, United Provinces, for improving hill cows.

Across the Borders

SOYBEANS AND SOIL CONSERVATION

By R. E. UHLAND

SOYBEANS may be handled so as actually to help in maintaining the productivity of the soil, whether grown for hay or for seed.

When soybean hay is fed and the manure spread back on the land, about 70 per cent of the hay's plant nutrients is returned. Little consideration has been given, however, to the plant nutrients contained in the soybean leaves, stems, and roots, or to the protection they can give to the soil against erosion if returned to the soil when the crop is harvested for seed. Growers, therefore, should be concerned with returning to the land as much of the nitrogen gathered from the air and as much as possible of the mineral matter taken from the soil.

Early investigational work on the analysis and yields of the different plant parts were carried on by the author at the Missouri Agricultural Experiment Station, and by H. L. Borst and L. E. Thatcher at the Ohio State Agricultural Experiment Station. The findings are reported in *Missouri Agricultural Experiment Station Bulletin* 279—February 1930, and *Ohio Agricultural Experiment Station Bulletin* 474—November 1931. The analysis reported covers four years' work at Missouri and six years' work at Ohio. The data given supply us with a good basis for determining the value of different parts of the soybean plant when returned to the land.

Soybean varieties differ widely in time of maturity, character of stem and lead, and adaptation to length of season. Some varieties have numerous branches, others few. The Missouri studies were continued from 1925-28, with the Virginia variety grown on two different types of soil. The studies at Ohio—made on the Manchu and Peking varieties—were started in 1922 and continued until 1927, but were not reported until November 1931.

The nitrogen determinations made on the various parts of the plants harvested at different stages of maturity made it possible to measure the total yield of nitrogen for the different harvests and also to determine its location in the plant. The nodule counts and root analyses gave an index of the nitrogen-fixing activities of the crop. As indicated by Table I, the amount of nitrogen found in the roots was quite low, averaging less than 4 pounds per acre. This indicates that if much nitrogen is to be added to the soil, it is necessary to return more than just the soybean roots. Cutting the hay at time of maximum harvest would have removed 115.7 pounds of nitrogen per acre. At the last harvest, when the seed was mature, most of the leaves had fallen, and they had lost some of their nitrogen. If the beans had been harvested with a combine there would have been from 40 to 45 pounds of nitrogen returned. The maximum yield of nitrogen in the tops for 1928 was 134 pounds per acre when drilled solid, and 101 pounds for soybeans planted in rows and cultivated. In 1927 when soybeans were grown as a catch crop the hay contained 57.2 pounds of nitrogen when drilled solid, and 35.8 pounds when cultivated.

R. E. Uhland is Research Specialist, Soil Conservation Service, Washington 25, D. C.

TABLE I

Pounds per acre of nitrogen in roots, leaves on plant and on ground, stems, and pods of Virginia soybeans at different stages of maturity. (Two years' results at Columbia, Mo.)

Stage of maturity	Roots	Leaves on plant	Leaves on ground	Stems	Pods	Total plants
4 weeks before maximum harvest	2.6	45.2	...	14.2	...	62.0
2 weeks before maximum harvest	3.8	58.5	...	23.7	24.6	110.6
Maximum harvest ...	3.7	31.1	19.1	19.2	46.3	119.4
2 weeks after maximum harvest	2.4	13.7	17.6	16.3	57.1	107.1
4 weeks after maximum harvest	2.2	6.3	14.8	13.3	69.9	106.5

Assuming that all the nitrogen contained in the dropped leaves would have been returned to the soil and that 70 per cent of the nitrogen in the harvest hay wuold have been returned in the manure, there would have been a return to the soil of 71.8 pounds in the cultivated crop of 1925, 107.5 pounds in 1926, and 93.8 pounds in 1928. It was calculated that slightly more than half of this nitrogen came from the air. By combining the soybeans for seed, it was estimated that there would have been a return of 51 pounds of nitrogen in 1925, 67.5 pounds in 1926, and 63.5 pounds in 1928.

The investigations of H. L. Borst and L. E. Thatcher at Ohio showed that earlier sowing dates for Manchu and Peking varieties were more conducive to higher yields of seed than of forage. Hughes and Wilkins at the Iowa Station at Ames reported similar findings. Table II shows the average pounds per acre of the principal plant nutrients found in the soybean leaves, stems, pods, and seeds for the Manchu and Peking variety. Maximum yields of nitrogen were obtained while the seeds were forming in the pods and before many leaves were lost. As was the case at Missouri, the nitrogen in the stems and leaves decreased rapidly as the plants matured. Part of this decrease was due to the movement of nitrogen from the stems and leaves into the seed while the rest was returned to the soil. The data shown in Table II were secured when the soybean plants had matured and when more than 45 per cent of the nitrogen was in the seed.

Table II

Pounds per acre of principal plant nutrients found in leaves, stems, pods, and seeds of Manchu and Peking soybeans. (Average for 2 varieties for 4 years at Ohio Agricultural Experiment Station).

Plant nutrients	Leaves	Stems	Pods	Seeds	Total tops
Calcium	57.5	14.6	11.4	2.2	85.7
Magnesium	25.2	12.1	6.5	2.3	46.0
Potassium	29.3	16.2	15.7	18.6	79.8
Phosphorus	7.3	3.3	2.6	9.8	22.9
Nitrogen	55.3	17.6	21.8	78.5	173.1
Dry weight plant parts	2,333	1,655	1,046	1,046	6,080

At maturity, if only the seed had been harvested, about 94.5 pounds of nitrogen would have been returned to the soil. If all the hay and seed had been taken off the land, it would have represented the removal of 85.7 pounds

of calcium, 46 pounds of magnesium, 79.8 pounds of potassium, 22.9 pounds of phosphorus, and 173.1 pounds of nitrogen per acre. If only the seed had been harvested, however, the average losses would have been 2.2 pounds of calcium, 2.3 pounds of magnesium, 18.6 pounds of potassium, 9.8 pounds of phosphorus and 78.5 pounds of nitrogen. This emphasizes the loss, especially of nitrogen and organic matter, when the soybean straw is burned or is not returned to the land.

L. E. Thatcher of Ohio, found that for 6 years, soybeans cut about the middle of September contained 7 pounds of nitrogen per acre in the roots, as compared with 4.9 pounds when harvest was delayed until the first week of October. At the September harvest, 39.1 pounds of nitrogen per acre was in the leaves, 14.7 pounds in the stems, 12.6 pounds in the pods, and 51.6 pounds in the seeds. When the harvest was delayed 2 weeks, 19.7 pounds of nitrogen was found in the leaves, 9.9 pounds in the stems, 10.1 pounds in the pods, and 72.1 pounds in the seeds. It is apparent that much of the nitrogen moves from the stems and leaves into the seeds. It is difficult to determine the extent of this movement, because of leaf-dropping as the soybeans approach maturity. The 6-year average showed that the amount of phosphorus removed by the crop harvested in either middle September or the first of October was 30 pounds of P_2O_5, equivalent to 150 pounds of 20 per cent superphosphate. The amount of potassium removed by the crop on these two harvest dates was 39 to 41 pounds of K_2O, equivalent to 78 to 82 pounds of muriate of potash.

It is generally recognized that a crop of soybeans leaves the soil loose. Observations and experiments have shown that the soil erodes easily following the removal of the crop, especially, when it is cut for hay. C. H. Van Doren and R. S. Stauffer reported on the effects of crop and surface mulches on run-off and soil losses on a 4 per cent slope at Urbana, III., in Volume VIII of *Soil Science of America* 1943. The experiments showed that when artificial rainfall was applied to clean cultivated soybeans at the rate of 1.75 inches per hour on a 4 per cent slope, the run-off was practically constant after the second hour. The run-off at the end of the first hour in April 1942 was 74 per cent and in June 1942 was 85 per cent. The soil loss for the first hour in April 1942 was 3,362 pounds per acre, and in June 1942 it was 4,881 pounds. At the end of 2 hours, 10,383 pounds of soil per acre had been moved off the plot, and 89 per cent of the 1.75 inches of rainfall was running off.

Where the soybean residue consisting of all the plants except the seed was returned to the surface, the run-off at the end of the first hour for October 1941 was 47 per cent, and at the end of the second hour it was 62 per cent. In April 1942, the run-off was 25 per cent at the end of 1 hour and 47 per cent after the second hour. The soil loss for October 1942 was 1,168 pounds per acre for the 2 hour period, and in 1942 it was 2,394 pounds. Thus, it is seen that the soil loss for October where the soybean residue was returned was only 11·2 per cent as great as where the residue was not returned. The residue was still active the next April, as the soil loss was 23 per cent of the soil loss without the residue.

Use of early maturing varieties allow for early harvesting of the soybeans and the seeding of winter grains or cover crops earlier than is possible with late maturing varieties. Winter cover crops which have a week or more advantage, when conditions are favourable for rapid germination and growth will generally produce much more organic matter and give better portection to the land. Late planted cover crops cannot be expected to give much protection against erosion in the fall and winter, and their growth the next spring is much behind those crops that have an early start and thus establish a well-developed root system during

the favourable growing season in early fall.

Erosion may be reduced further and more fertility saved by delaying the preparation of the land and the planting of the soybean crop a week or more in the spring. At this time of year, the growth of the hay or cover crop is very rapid, and the increase in organic matter may be measured in hunndreds of pounds for every day that ploughing is delayed. Additional savings of soil and fertility may be made by drilling the soybeans in 8-inch rows instead of 42-inch cultivated rows. Contouring is recommended for all sloping land whether the beans are drilled solid or planted in 42-inch rows and cultivated.

From these run off and soil-loss data it is obvious that by returning the leaves, stems, and pods of the soybean plants to the soil surface a large saving of soil and water will result. The soil loss from land where the soybean hay was removed and the land left bare was 129 times as great as where it was mulched with 2 tons of wheat straw. By removing only the soybean seed and leaving all the leaves, stems, roots, and pods on the land, more than half of the nitrogen contained in the soybean is returned, and erosion is also markedly lessened.—Reproduced from *Soil Conservation*, October, 1946.

Home Gleanings

THE REORGANIZATION OF GAUSHALAS AND PINJRAPOLES IN INDIA

By SIR DATAR SINGH

'GAUSHALA' literally means the home for cows. As compared to Pinjrapoles where all kinds of animals are maintained, gaushalas cater only for the bovine family. These institutions are India's great heritage and form a concrete example of the Indian reverence and affection for animals and particularly for the cow. Protection and service of the cow is an article of faith and a part of religion with the Hindus. We read in ancient Hindu books, how Emperor Dilipa, a forefather of Rama, offered his own life in lieu of his preceptor's cow, Nandini. Arjuna courted exile for twelve years in order to be able to rescue a Brahman's cow.

The cow is almost defied in the Vedic and post-Vedic literature. Anybody who studies the Vedic hymns even cursorily will undoubtedly be struck by the importance and significance attached to cattle during Vedic times. The seers and sages belonging to this early period of the history of mankind were fully alive to the important role played by the cow in humanity's life and economy. It was, indeed, considered to be the symbol of the nation's economic prosperity. Thus, with the ancients, the sentiment for the cow was an intimate aspect of their conception of life and religion. It was under these religio-economic considerations that gaushalas and pinjrapoles originally came into existence. But, as those old days have gone, so what remains of the spirit of the service of the cow is only a symbol without the spirit.

In order to study in its true perspective the present position of these institutions and their role in the economy of the country, a brief reference to the condition of cattle in general will not be out of place here. Cattle breeding in a country like India, which has one third of the world's cattle concentrated in about one-fortieth of the habitable area of the globe, may apparently seem very rosy, but, in reality, it is not. From the economic point of view, the position of cattle in India is very unfortunate. India possesses 215 million cattle, which is the largest number of any country in the world. But the production of milk is the lowest when worked out on the basis of *per capita* consumption. Estimates indicate that the average consumption of milk per head per day does not exceed seven ounces, which is about one-fourth of the nation's normal requirements. This is due to the very low production of the Indian cow. The average quantity of milk produced by an animal in a year is computed at only 750 lb., which is not nearly enough to pay for her food and care. Then again, the interval between two successive lactations is considerably longer than in most countries Therefore, the cow, at the present moment is anything but an economic proposition in India.

Under such appalling conditions of cattle prevalent in the country, the position of gaushalas and pinjrapoles cannot be expected to be better than it is. It is estimated that there are, at present, about 3,000 gaushalas in India, with a population of over six lakh heads of cattle which are being maintained at a cost of over 80 million

Sardar Bahadur Sir Datar Singh, Kt., F. R. S. A., is Vice-Chairman of the Indian Council of Agricultural Research, New Delhi.

rupees per annum. A rapid survey of the present condition of these institutions has revealed the following facts:

(a) Gaushalas and pinjrapoles are generally situated either in the heart of big towns or in their immediate neighbourhood, which makes the housing as well as feeding of cattle very uneconomic.

(b) In most of these institutions the tendency is to overstock with the result that the livestock is generally underfed and not properly looked after. This entails great hardship and suffering for the animals.

(c) There are no means of segregating the productive animals from those which are aged, infirm or otherwise economically useless. Thus, no discrimination is practicable in the feeding of good cows from that of unproductive ones, which makes good animals also worthless after a short time.

(d) Generally very little land is attached to the gaushalas for grazing of cattle or for raising of fodder crops.

(e) No attention is paid towards the breeding of cows which are allowed to be covered by nondescript bulls.

(f) These institutions are generally managed by untrained staff. Thus, the whole system is worked under no definite scheme of management. There is no planned policy for breeding and feeding of different types of animals on scientific lines.

But, in spite of all the above-mentioned drawbacks from which these institutions are suffering at the present moment, my experience has shown that these places, if reorganized on proper lines, can very well serve the purpose of improving cattle and educating the people in the service of the cow on modern scientific lines. The financial resources of most of these institutions are ample. They have, in addition, public sympathy. What is needed is just to put them on right lines.

It has been estimated that out of the total population of about six lakhs cattle in the gaushalas there are about 20 per cent which can be classified as good dairy type. There are another 20 per cent which are good for breeding though not highly productive. By better feeding and management of these animals, it will not be too much to expect to raise, on an average one seer (a seer=2 lb.) of milk per cow per day. This will amount to an increase of 3,000 maunds (a maund=82 lb.) of milk per day which, in my opinion, will be no mean addition to the present production from this source. It is further estimated that these institutions when reorganized on improved lines, will provide about 25,000 males fit for use as stud bulls every year for replacement in the gaushalas and for free distribution in the neighbouring areas for the improvement of ordinary village cattle. In addition to this, there will be about the same number of males available for bullock work and 50,000 improved female calves every year. These institutions can also serve the purpose of providing suitable centres for the salvaging of dry cattle from cities and towns. At present, due to lack of such facilities, about 80 per cent of really fit animals which go to the big towns find their way to the slaughter-houses after they go dry: In my opinion, therefore, the gaushalas and pinjrapoles do not only possess great potentialities as a means of improving the milk supply of the town but can also serve as centres for the preservation and betterment of the cattle wealth of the country. There is absolutely no doubt that gaushalas can serve a very useful purpose in successfully tackling many economic probelms facing the country, such as

(a) the production of more milk for supply in urban areas,

(b) the production of breeding bulls for distribution among villages, and

(c) the salvage of dry but useful cattle.

For the achievement of these objectives, I have been endeavouring to reorganize these institutions on scientific and utilitarian lines. It is, of course, difficult to suggest a common plan for

the improvement of these institutions situated under such widely differing conditions, yet a general skeleton plan on which the improvement is being sought is given below:

(a) The immediate problem is to segregate the productive animals of the gaushalas from those which are aged, or otherwise uneconomic. The removal of the useless stock to rural areas, preferably to some forests reserves, will not only remove the congestion in these institutions, but will make it possible to improve the feeding of productive animals which will be quickly reflected in their improved yields. For this purpose every province can be conveniently divided into zones. Forest reserves can be utilized with great advantage. Useless animals from all the guashalas situated in each zone should be kept on the grazings available in such reserves. These cattle should not be allowed to propagate. The feed and fodder thus saved can be more economically utilized in improving the yield of productive animals kept in the gaushalas in or near the towns.

(b) The next step is to provide improved pedigree bulls, in the beginning, as basic stock for the grading of cows.

(c) As far as possible to encourage the establishment of dairy and breeding sections in each gaushala in order to supplement the supply of good quality milk to the urban population.

(d) To make arrangements for the establishment of training centres for gaushala workers in each province and the major States. The syllabus for such centres covers cattle management, breeding and feeding and elementary principles of milk production on modern lines with an emphasis on the practical side of the whole subject. Special attention will be devoted to local requirements of each area.

(e) Appointment of one Gaushala Development Officer with adequate staff for each province to help these institutions in carrying out the above improvements.—Reproduced from the *Journal of the Royal Society of Arts*, June 21, 1946.

Book Reviews

WHITHER AGRICULTURE IN INDIA

By Dr Baljit Singh (Published by N. R. Agarwal and Co., M. K. Garden, Agra, pp. 346, Rs. 8.)

IT is a happy sign of the times that the volume of literature on various economic problems in India is increasing. Dr. Baljit Singh's contribution must be regarded as one of quality. He writes with ripe and first-hand experience of the subject and covers a wide field, both historically as well as in range of problems discussed. The foreign student interested in the Indian agricultural problem, will find his book informative. Even those acquainted with the problem will find fresh approach to various matters analyzed. The length of the book and the two frequent quotations may be regarded as the only defects. But many who may turn to his book as an introduction to the study of the subject may be grateful to the writer for these very features of his book, as it is not easy these days for every reader to obtain the sources from which the learned author has quoted.

Temptation is great to write in detail about the special aspects of the book. It will, however, serve the purpose of review, if a few references are made to the text. It is hoped this will provide sufficient stimulus to the reader to study the book itself. For instance, Dr Singh is perfectly right when he remarks 'the laws on self-government by the village makes a turning point in the history of Indian agriculture.' Throughout the book he has made suggestions how village community life should be re-habilitated, which in turn would revive and restore village economy to its right place in the Indian economic situation in its totality. There are dangers, of course, of planning from the exclusively village point of view. The idea of village self-sufficiency, however, alluring can hardly be commended under present circumstances. Village self-sufficiency inevitably leads to subsistence economy. The entire trend of Dr Baljit Singh's book is to move away from the standards of self-sufficiency to those of national and inter-national economic integration. This is an important contribution of his book.

Dr Baljit Singh in his analysis of agricultural practices and the mode of living of the peoples in the village has laid great stress on old traditions and practices. He is of opinion that caste inhibitions and the like may prove a serious obstacle in the path of economic betterment. We are not much able to share his views in this connection. The forces that are afoot even in the rural areas and in our village communities point the way hopefully towards rapid change both in agricultural operations and way of social living.

The writer has rightly emphasized the importance of mixed farming for a country with our peculiar features, especially in reference to small scale farming. It is hoped that either through the collective, or more appropriately the cooperative channels much progress can be achieved. But no single system however beneficial in itself, can remove the poverty that prevails in the country.

His discussion of the topic of agricultural rent deserves special attention. The matter of land tenure system is one that is basic to the entire reorientation of our agricultural economy and the suggestions offered by Dr Baljit Singh deserve consideration.

His ideas about crop planning are generally accepted by most students of the problem. The difficulty however will be to produce a masterplan and to see that it is efficiently and honestly implemented. Here lies the weakest link of the chain. We would rather advocate the attempt to plan in some restricted fashion, preferably associated with some of the regional development

plans envisaged by some provincial governments. To attempt to cover the entire country, to our way of thinking, would be fraught with much danger and may actually lead to failure.

Dr Baljit Singh has given particular attention to the cattle problem and is to be congratulated for emphasizing the matter of raising special fodder crops and concentrates and the like. It is obvious that our agricultural economy cannot flourish with under-nourished cattle. The author has brought out this matter in special manner in a chapter dealing with Animal Husbandry and Dairying.

The writer has laid great stress, and rightly, on the subject of agricultural marketing. It is only through enhanced profits that the producer can secure the necessary incentive for improving both his methods of agriculture and ways of raising his cattle. Dr Singh rightly states that marketing is the crux of the problem of rural prosperity.

The author has laid adequate stress on the vital question of State aid, education and research, an aspect which is frequently neglected by writers on agricultural topics. Probably no country needs more of research for its agricultural betterment than India. We would suggest that in all such endeavours, apart from specialized institutions created for the purpose, the existing Universities should be closely associated in all such work.

In short, Dr Baljit Singh's book *Whither Agriculture* is a profitable and stimulating reading. (S. K. R.)

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A MONOGRAPH ON AGRICULTURE I. TRENCHING

BY SAM HIGGINBOTTOM, M.A. (Econ), M.Sc., B.Sc. (Agri). Published by the Kitabistan, Allahabad, pp. 15, As. 9).

COMPOSTING of vegetable and animal wastes has attracted considerable attention from scientists and agriculturists, but the direct incorporation into the soil of un-composted raw refuse has not been studied in similar detail. The latter system possesses the attractive features of simplicity and low cost of operation, due to the elimination of the composting process. In the case of green manures, the composition of different types of green manures, and the conditions under which they could directly be applied to land so as to give a beneficial effect on the succeeding crop, are known with a certain degree of definiteness, but similar information relating to materials of the type of town and village refuse or mixed farm-wastes is very meagre.

The general objections to the turning in of un-decomposed organic material into the soil are the carbonaceous nature, in general, of the waste material which temporarily immobilizes the nitrogen present in the soil and thus prejudicially affects the growth of the succeeding crop, the possible presence of weed seeds in undecomposed refuse, possible depletion of soil moisture due to application of dry material which decomposes rapidly, and possible transmission of plant and animal pathogens from un-composted raw refuse. In addition, the land may be carrying a crop when the refuse arrives and hence the latter may have to be stored till the land is ready to receive the manure, which introduces the same problems as composting.

It may be possible, however, to overcome most of the objections stated above by burying the refuse at some depth below the surface soil. This is the method which is recommended by Dr Sam Higginbottom, who is familiar to Indian workers for his pioneering work at the Allahabad Agricultural Institute. As a result of 33 years' experience, he strongly recommends the opening out of trenches (say 5 ft. breadth and 1 foot depth) in the land itself and burying the daily output of household and village refuse in such trenches. Full details of the method are given in this brochure.

The author's experience has shown that wonderful crops can be obtained on lands 'trenched' in the above manner.

The method would appear to have special utility in the case of areas surrounding villages and towns, where intensive cultivation of vegetables or garden crops is carried out. Water supply must be adequate. The cost of 'trenching' a land 'all over' is estimated at Rs. 125 per acre on the basis that a man can open and close a strip of land 75 to 100 ft. long and 5 ft. wide in one day, but it is doubtful whether an average Indian farm-hand would do even half the above work, and the expenses can safely be estimated at a minimum of Rs. 250 per acre. The above high rate of expenditure may, however, be warranted in certain cases of 'truck' gardening and to such farmers the present brochure would offer useful suggestions. (C.N.A.)

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THE INDIAN SUGAR INDUSTRY (1945-46) ANNUAL

EDITED BY M. P. GANDHI. (Published by Messrs. Gandhi & Co., Jan Mansions, Sir Phiroz Shah Mehta Road, Bombay, pp. 118. Rs. 6-8-0.

THE Indian Sugar Industry Annual, 1945-46, edited by Mr. M. P. Gandhi is a treasure-house of valuable information regarding sugar. It has assembled in a form convenient for reference statistics relating to the production and marketing of sugarcane, sugar and allied products in this country. The present publication fully maintains the high standard of the editor's previous publications on sugar.

The author has reviewed at length the working of the season 1944-45, and 1945-46. The production of factory sugar in 1944-45 was only 9,53,500 tons as compared with 12,16,400 tons in 1943-44. The two main reasons for the poor output were shortness of the working season and the failure of as many as 24 factories to work during the season. Inspite of restrictions imposed by the Goverments under the *gur* control order, on the manufacture and marketing of *gur* the supply of cane to sugar factories was inadequate. In author's opinion the most important factor which affecetd the production of sugar in the United Provinces and Bihar was the low price of cane fixed at only As. 14 per maund which was not on a parity with the price levels of other commodities like wheat and affected greatly the supply of cane to sugar factories. The transport difficulties also resulted in a shortage of cane supplies to factories. Further, the lack of supplies of manure and other fertilizers and irregular supply of other matrials like sulphur, coal, lime, etc., also resulted in a lower production of sugar during the season. For the season 1945-46, the author gives an estimated production of 9.66 lakh tons. The main reason for the decrease is the shortness of the season in the United Provinces and Bihar due to inadequate cane supply. The author does not see better prospects for the season 1946-47 as well and concludes that at least before 1947-48, the country will not get as much sugar as she requires.

There is great scope for increase in sugar production in India and there is necessity for further expansion of the sugar industry to meet the increased requirements. The author feels that there is at present a concentration of the sugar factories in the United Provinces and Bihar and it is essential that for enabling the various undeveloped provinces to derive benefits from the establishment of this industry, any further expansion of the industry should be made particularly in Bombay, Madras, Bengal and other provinces which are areas of deficit production. The period of the present protection to the industry will expire on 31 March, 1947. The author suggests that the protection to the industry should be continued at the present level for a further period of three years. The Tariff Board should conduct an enquiry during these periods as conditions are likely to be normal by the year 1948. The Government should take full care to ensure the development of the industry on sound lines and in a manner in which the interests of cane growers and the manufacturers are fully safeguarded.

There has been a rise in sugar prices during the last four years due to the increase in the prices of cane, etc., but taking into consideration the achievement fo the Indian sugar industry the small sacrifice on the part of the consumers has been fully recompensed.

The author has also given full descriptions of various controls to the industry instituted by the Central and Provincial Governments.

Reference has also been made to the industry's present problems and its future prospect. The greatest need of the industry is for consolidation and re-organization. There should be further improvement in the cultivation of cane. There is ample room for improving the yield of cane in India. Methods should be devised for the economic utilization of molasses and other bye-products of the industry. A reference has been made to the work of the Imperial Institute of Sugar Technology as well as that of the Sugarcane Research Station, Shahjahanpur in 1944-45.

The Annual is a valuable reference book and directory on sugar, and is well worth perusal by any one interested in sugar. (S. C. R.)

ERRATUM

Indian Farming, Vol. VIII, No. 5, May 1947

Frontispiece:

for 'Silk Cotton Tree (*Semal*) (*Bombax malabaricum*)'

read 'Yellow Silk Cotton Tree' (*Cochlospermum gossypium*).

News and Views

I. A. R. I. DIPLOMA

THE following students of the Indian Agricultural Research Institute, New Delhi, have been awarded the Diploma of the Institute (Assoc. I.A.R.I.) after completion in September 1946 of the two-year Post Graduate Course and acceptance by the Institute Council of the theses sumbitted by them as mentioned against each.

Agricultural Botany and Plant Breeding

No.	Name of student	Title of thesis
1.	Narendralal Dhawan	Interspecific hybridization in *Sesamum* L.
2.	S. Basharat Ali Shah	Colchicine-induced polyploidy in different varieties of chillies (*Capsicum annum*).
3.	V. Ramamurthy	Pt. I. Studies in the seed-coat anatomy of *Brassica* species. Part II. Studies on colchicine-induced polyploidy in some Imperial Pusa types of *Sesamum orientale* L.
4.	Choudhry Mohd. Sharif Sardar Khan	Influence of late sowings of wheat on yield and variation in plant characters.
5.	Yogendra Mohan Upadhyaya	Variability and the role of natural selection in wheat varietal mixtures and hybrid generations.
6.	Shyam Narain Sharma	Effect of temperature on the development of wheat grain.

Agricultural Chemistry and Soil Science

No.	Name of student	Title of thesis
7.	Khubo Gianchand Tejwani	Effect of nitrogenous and phosphatic fertilizers on soil fertility and crop composition when legumes are either included in, or excluded from the rotation (A lysimeter study).

Entomology

No.	Name of student	Title of thesis
8.	Parkash Lall Renjhen	Pt. I. On the morphology of immature stages of fruit fly *Dacus cucurbitae* Coq. with short notes on its biology. Pt. II. Our present knowledge of the insect pests in India of the important edible fruits of the family Rosaceae.

Entomology

No.	Name of student	Title of thesis
9.	Abdul Mannan	Pt. I. The survey of insect pests of dried fruits. Pt. II. Biology of the saw-toothed nuts beetle *Oryzaephilus mercator* Fauvel, with description and bionomics of one new species of the genus *Stathmopoda*. Pt. III. Thorough review on the work done on most important pests of dried fruits, with a separate chapter on control measures.
10.	Mohammed Mohsin	Pt. I. Studies on the role of nutrition in the longevity and fecundity of *Microbracon gelectise* Astom. A larval parasite of potato tuber moth. Pt. II. A review of the work done in the control of the surgarcane moth borer, *Ditraea saccharalis* Fab. by its egg parasite, *Trichogramma minutum* Riley.

Mycology and Plant Pathology

11.	Hari Krishna Saksena	Studies in the physiology of *Ustilago tritici* (Pers) Rostrup causing loose smut of wheat.

Sugarcane Breeding

12.	Obaidullah Jan	Pt. I. Sugarcane breeding with special reference to the work done in Coimbatore. Pt. II. Some studies on the influence of the size of the sugarcane setts, location of nodes and the depth of planting on the germination, tillering and final stand of the crop.
13.	Om Parkash Agarwal	Pt. I. The activities relating to the production of Co. canes with special reference to the breeding work at Coimbatore. Pt. II. Studies on the effect of photo-period factor on growth of sugarcane.

(I. A. R. I.)

HILL FARMING IN BRITAIN

Half of the 16,000,000 acres of Hill Farms in England are situated in the magnificent tourist area of the Welsh mountain. In Scotland, there are 10½ million acres. Although the hill in England generally speaking due to better soil conditions, are not suffering from the same acute depression as in Scotland and Wales, the Welsh Mountain Hill farm problems of today are reflected in many aspects in the three countries. In the days of prosperity the Welsh hill farmer did not rely purely on sheep but also on dairy farm butter and store cattle. But with the introduction of refrigerator came the vast importation of butter and beef from overseas. It was soon uneconomical for the hill farmer to rear cattle and slowly the herds almost disappeared from the farms, leaving the hill farmer sheep and its two products, a low-grade black-faced wool suitable only for carpet making, and the famous Welsh mutton. This did of course, apply to the lowland farms which bred, and still breed, the famous pedigree sheep that are exported throughout the world. The wool from the hill sheep did not yield a sufficiently good income, and when the cattle left the farmlands the soil became sheep-sour and the grazing inferior. Families split up as the younger members sought a more worthwhile income in the industrial areas. The farms were small and therefore uneconomical, and the sheep too in-bred and in consequence less hardy.

In between the two wars of this century, the general conditions were acute, and incomes too small for family maintenance. Both the sheep products —wool and mutton—had depressed markets. To-day two big features are being introduced which, it is hoped, will once again bring adequate returns to the hill farmer. In order to investigate the problems confronting the farmer, two committees were set-up, one to report on the situation in England and Wales, under Earl de la Wair, and the other in Scotland under Lord Balfour of Burleigh. On the results found by these two Committees the new Hill Farming Bill was introduced into Parliament and has now passed its Third Reading. It has the object of making provisions for promoting the rehabilitation of hill farms, the payment of subsidies for hill sheep (at present 7s. for each breeding ewe) and cattle, for controlling the keeping of rams and ram lambs, and regulating the burning of heather and grass. Whether the amount of £4 million for five years is adequate for this development is still open for debate. There is a drive to make the cottages more attractive and the pay better, to lure the younger families to the isolated hill farms, with the introduction of electricity and the development of roads, schools and social welfare. At the moment the farms are too small and are worked mainly by the older families. The second aspect is the development of afforestation by the Forestry Commission. Much of the hill farming area is suitable for afforestation, and provided it does not absorb the best grazing lands, it will guarantee the hill farmer over 200 days' employment in a year, and in a few years provide additional income from the secondary products derived from forest thinnings. That leaves only the guarantee of a stable market for the farm products and the hill farmer's future will no longer be the precarious career of the past thirty years.

(U. K. P. S.)

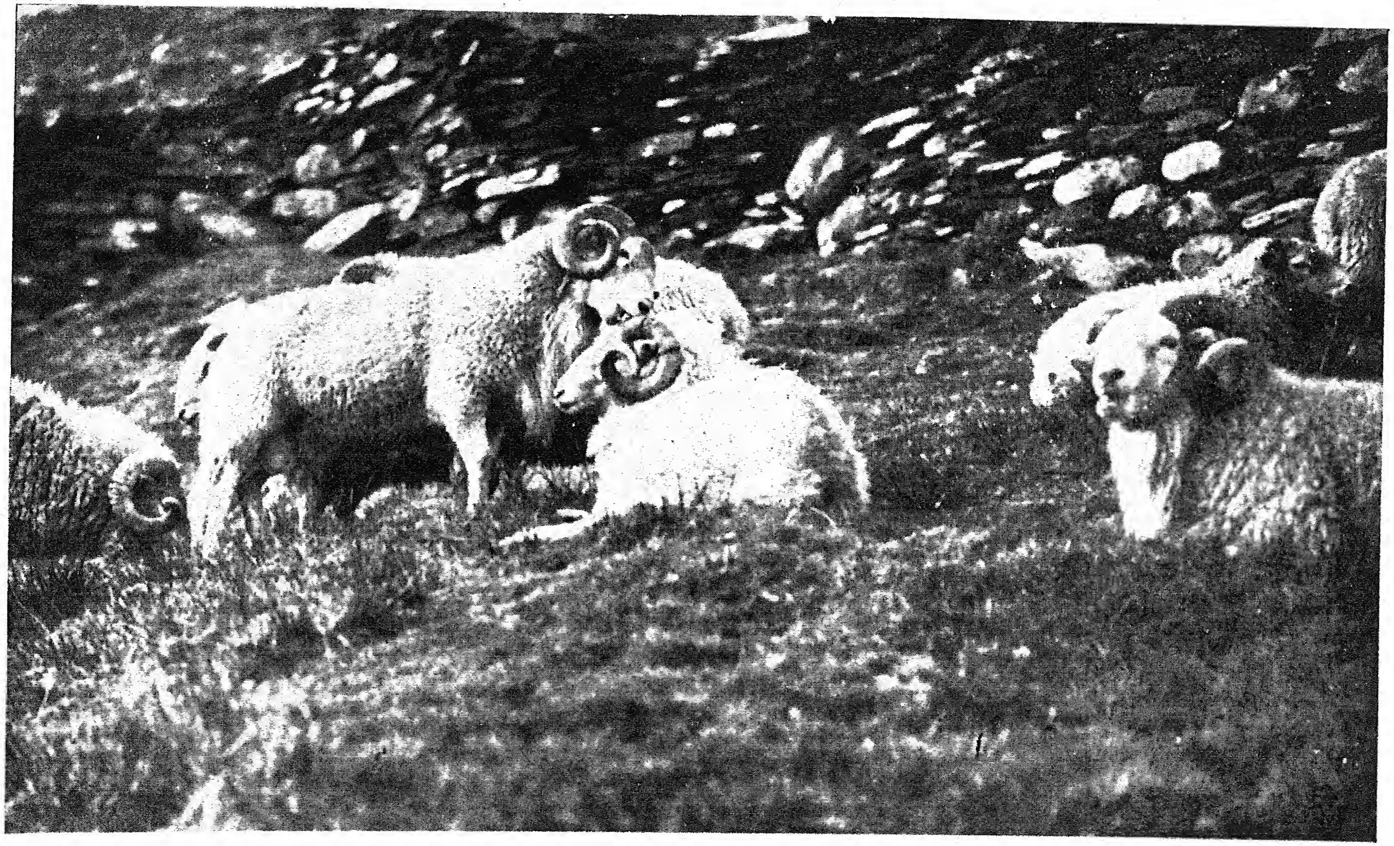

Fig. 1. The rams like the ewes are strong and hardy, and can graze on the poorer grasslands of the upper- levels.

PLATE 67

Fig. 2. Down the slopes run the small batches of sheep, driven by the hardy little sheep dogs.

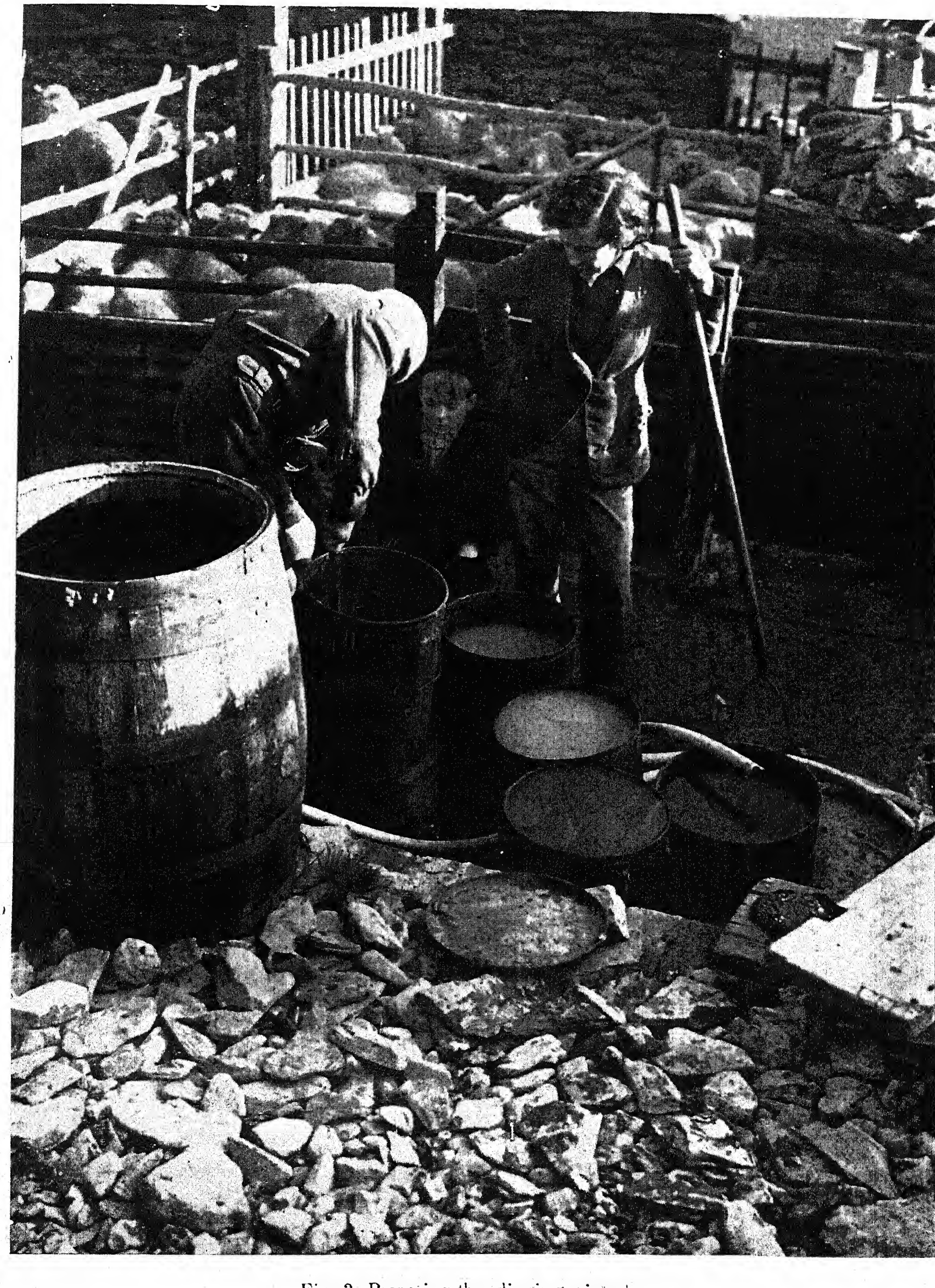

Fig 3. Preparing the dipping mixture.

Fig. 4. And now they are ready for dipping.

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INDIAN FARMING

JULY, 1948

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FRUIT INDUSTRY IN THE INDIAN UNION

THE partitioning of the country has created a series of new problems in the fruit economy of the country. For not only some of the most highly developed centres of fruit production such as Peshawar, Canal Colonies of the West Punjab and Quetta are lost but as many as 203 licensed fruit products establishments including some leading manufacturing concerns have also been lost to Pakistan.

Planning for the fruit industry of India under the changed situation after partition involves, therefore, an entirely different approach to the one already recommended by the National Planning Committee. In the first place, there is now an urgent need to acquire a first hand information in respect of the acreage yield of different varieties of fruits grown in various parts that have seceded from the Union. At present the only authentic source which gives some information on the subject is the annual volume of the *Agricultural Statistics of India* wherein acreage in respect of fruits is combined with that for vegetables and root crops. Moreover, even this source does not give recent figures in respect of Indian States. The correct statistical information which forms the basis of future planning must be made available at all cost.

Based on the available data, out of 41,26,000 combined acreage of fruits and vegetables and root crops in pre-partition India (excluding States) we have lost to Pakistan hardly 20 per cent, but in terms of tonnage and quality and types of certain fruits our losses are many times more. At present the estimated combined acreage left for fruits, vegetables and root crops in the Indian Union Provinces is about 30,78,000 which only forms about 1·7 per cent of the total cultivable area in the Indian Union Provinces, or about an acre for over 75 persons. On conservative estimates to provide for the desirable minimum nutritional quantum of 4 oz. of fruits alone *per capita* per day for the estimated population of the Union Provinces only (23,31,48,000 in 1942), we need over 44 lakhs of acres under fruit crops (presuming approximate yield per acre as 47 md. of fruits and reducing the population as to 80 per cent adult equivalent). But keeping in view the needs of the preservation industry as well as the ever-increasing population our target should be still higher, i.e. about 60 lakhs of acreage under fruits alone. The most disappointing feature of the story is not the under-acreage, but abnormally poor yield and low quality of fruit in the Union Provinces, the general verdict of the technologist in the industry being 'not fit for canning'. This further shows the desirability of improving the efficiency and ability of the fruit growers with a view to build the Indian fruit industry on a sound and solid foundation.

It is admitted, however, that there are great potentialities for increasing fruit production in the Indian Union. The Union enjoys a variety of climates and soils. There are numerous fertile pockets in various provinces which could be developed profitably with the advent of irrigation schemes to increase production of quality fruits and vegetables. There exist numerous horticultural varieties of fruits also. It only requires sorting out of varieties to select finally quality and high yielding strains which could help the Union in augmenting fruit production to compete with any fruit producing country such as Italy, France and California.

It is opportune time to formulate a fruit development policy. Strong organization also is needed to handle the development of fruit industry in a systematic manner. Lack of

organization at present is the chief hindrance in the way to step up production. What is needed most, is the creation of regional Horticultural Boards and a Central All-India Horticultural Board on the model of the U.P. Fruit Development Board to act as liaison agencies between the Government and the growers to foster the national fruit industry of the country on sound, scientific and progressive lines.

The pivotal point in formulating the Union policy as regards fruit development lies not only in selecting productive strains of commercial fruits as pointed above, but also devising measures to eliminate waste due to pests and diseases and setting up adequate organizations to conserve the residual production if and when a glut occurs due to lack of transport facilities.

As regards improvement in the quality and yield of fruits very little effort has been made in the Union. Some selection of indigenous fruit crops such as guava and pomegranate have been made in the province of Bombay. Lucknow 49 strain of guava and G.B. No. 1 pomegranate are decidedly superior strains as compared with the local production. There appears to be increasing demand for such strains. Hardly any selection of any other fruit crops is worth noting. Recently, however, an attempt is being made to hybridize mango varieties in the province of Madras. The result of these investigations is yet to be seen. Almost all horticultural workers in the Union have been busy with the testing of varieties and introducing foreign strains. The Union is rich in variety collection and here one can find a nucleus for future development. Several strains of citrus such as, Marsh seedless grapefruit, Eureka lemon, Valencia late, Blood red, Jaffa orange, Malta orange, and numerous varieties of apples such as Baldwin, and Cox's Orange Pippin have been introduced. The introduction of these varieties is undoubtedly a step forward in this field of development.

Incidentally it may be mentioned that quite a useful work is being done in many provinces in testing rootstocks of citrus and apples and also valuable field observations have been made in testing the influence of manure on yield and quality. Research in the method of propagation has, however, not made much headway. This is another profitable field to be exploited.

One of the most important causes of low production of fruit crops is due to the damage to blossom and fruit by pests and diseases. Although entomological and pathological research is forging ahead in several provinces, very little is done by way of finding successful remedies against pests and diseases of fruit crops. Some half-hearted trials here and there have been recorded. But no remedy for fruit fly, citrus die-back, fruit borer, root-rot, cracking of bark and such other diseases are in sight. A concentrated attempt to protect crop and minimize damage is badly needed and this offers a rich field for investigation in the future.

As regards conservation of fruits, a beginning is already made. The Government have declared fruit industry as protected industry. Laws to standardise fruit products and ensure hygienic conditions are already functioning. Protective tariff on imported preserves is also levied from the beginning of this year. All preserved manufacturers are licensed. The Institute of Fruit Technology provides research activities to solve the problems of preservation behind this set up. In spite of all this, however, the industry is not progressing. After a high war boom the production has gone down, due to post-war heavy dumping of American Army surpluses for the civilian markets. The containers are not available. The fruit and vegetable prices are prohibitive. Due to decontrol of sugar the commodity is not available at a cheap rate. One Bombay importer has been offering fruit pulp from Australia at the rate of as. 3 per lb. in 50 lb. tins (2 tins to a case), i.e. about as. 2 per lb. naked. Whereas apple is sold at Rs. 5 per 40 lb. box in New Zealand, it is sold at Rs. 30 per 40 lb. box in this country. Onion is sold at as. 8 a seer. Lemon is sold at Rs. 40 per maund (80 lb.). All fruits are dear. The industry is paralyzed. A critical study of the existing situation of fruit industry convinces one that it is an uphill task to control the various factors affecting the industry.

The first and foremost step to augment production is to survey the entire Union tracts and lay figner on the spots where fruit crops could be easily grown and extension is possible. The next is to set up an organization to make the fruit and vegetable cultivation more economical by making quality and productive strains available for distribution and by providing quick transport to markets. Again in the new set up, the question of

establishment of a chain of commercial cold storage plants has yet to be planned. Doubtless cold storage plants have to play a very conspicuous part in avoiding gluts in the market by regulating and extending the period of availability of fruits in different areas and in different seasons. Transport and market will play a great part in increasing production. It is on such lines that the fruit policy must be laid to stimulate production.

Original Articles

MANUFACTURE AND STORAGE OF *GHEE*

By N. N. DASTUR and B. N. BANERJEE

THE production of milk is closely correlated with the quantity and quality of feed given to cattle, for this reason, there is a wide fluctuation in the quantity produced during different seasons. Usually the season for maximum production starts from September, reaches a peak in November and continues till March: the season of lowest production starts from April and lasts till August. When milk is produced in larger quantities than what is required for the use of the local community it is necessary to find some means of preserving it whole or of preserving some of its major constituents or even only one of its least perishable constituents. Under the first category may be cited such products as *khoa*, condensed milk or milk powder. Under the second head will come different varieties of cheeses. *Ghee* will come under the third category. Of all the constituents of milk, *ghee* is the easiest to separate without the use of very complicated machinery: it has comparatively very good keeping quality.

Ghee-*making*: *an ancient industry*

Ghee is the pure fat of milk. Commonly it is made from cow and buffalo milk, but in certain isolated areas *ghee* from goat and sheep milk is also prepared. *Ghee* has occupied a very prominent place in the Indian dairy industry from the earliest times and this is continued even to-day. It is estimated that approximately 58 per cent of the milk produced in our country, totalling nearly 3,589 lakh maunds, is utilized for making *ghee*. The value of *ghee* produced was over 100 crore of rupees per year in pre-war days. *Ghee* that is produced in the country is to a very large extent consumed in the country. The quantity produced, though so huge, is the joint effort of every tiny village. Any improvement or defect that may be consciously or unconsciously introduced will thus have a profound significance both on the final value of *ghee* and its market value. Even though various other fats, like vegetable oils and hydrogenated vegetable oils, are available in large quantities and at a much lower cost, the demand for *ghee* continues to increase. It is thus in everybody's interest that the best quality of *ghee* be produced. *Ghee* production as mentioned above has been practised from the earliest times and it is not a matter of wonder that during that time bad practices as well as good have entered into the routine of manufacture. It is the intention of this article to analyze in the light of science, such step in the process of *ghee*-making so that the bad ones may be omitted or changed and the good ones confirmed or introduced, the ultimate object in either case being the production of only the best quality of *ghee*.

N. N. DASTUR, M.SC., PH.D., A.I.SC. is Dairy Chemist, Indian Dairy Research Institute, Bangalore, and B. N. BANERJEE is on the Staff of the Indian Institute of Science, Bangalore.

Isolation of ghee

Ghee can be isolated from milk by various methods. No one method can be described as the best but, if certain precautions are observed, good *ghee* can be produced by any of them. The different methods followed to-day in the country may be summarized as follows:

1. Desi *method*: Milk is converted into curds, butter is isolated and this is heated to obtain *ghee*. This method is most widely used.
2. *Creamery butter method* (*Mukhan ghee*): Cream is obtained from milk by the use of mechanical separators. Butter is prepared from this cream after souring and then it is melted to *ghee*.
3. *Cream method*: Thick cream is prepared by the use of mechanical separators and, after souring, is heated directly and *ghee* is obtained.
4. *Vacuum pan method*: Creamery butter or thick cream is freed from water by heating

under vacuum at a low temperature till pure butterfat is obtained.

5. *Direct from milk:* This is prepared by churning cooled milk after heating it first. This method is used only in rare instances and hence is not of commercial importance.

Under each of the above heads many modifications are practised, e.g. in the *desi* method raw or boiled milk may be used; curds of various degrees of acidity may be prepared; the butter obtained may be stored or at once converted into *ghee; ghee* may be first kept as *kacha ghee* and then made into *pucca ghee;* and so on. The modifications are adopted as are best suited to the local conditions and the market demand. However, if *ghee* of uniformly high quality, i.e. having good keeping quality and retaining all its nutritional factors, is to be produced throughout the country, it will be necessary to modify the methods to some degree. To understand why these modifications are necessary it would be best to understand first the various factors which may contribute to the spoilage of *ghee*.

Spoilage of ghee

A chemical examination of *ghee* reveals that it contains about twenty-two different fatty acids which are held in combination with glycerine. A fresh sample of *ghee* will not contain any free fatty acids. This combination can however be broken up fairly easily by giving favourable natural conditions during storage, e.g. presence of oxygen, light, moisture, etc. When this takes place *ghee* begins to go bad. The same result can be brought about artificially, for example, by the addition of any alkali when the acids are detached from glycerine and soaps are formed. Further, the process of decomposition is catalytic, i.e. once the decomposition has started the products of decomposition further help to decompose good *ghee*. It will, therefore, be readily understood that care must be exercised at every step and any neglect at one point may spoil the whole product. It is extremely difficult to arrest the decomposition process once it has started. Besides glycerine and fatty acids, *ghee* contains other valuable substances in minute quantities like carotene, vitamin A, etc. which are important not only from the nutritive point of view but also because of their property of imparting additional stability to *ghee*. In *ghee* that is decomposing, these substances are destroyed or converted into entirely different products which do not have any useful purpose.

The spoilage in *ghee* may broadly be divided into two groups—(A) development of free fatty acids and (B) development of rancidity. Each of these will be discussed in detail below.

(A) *Development of free fatty acids in* ghee

Ghee that is prepared under clean conditions and stored carefully will not have more than 0·2 to 0·5 per cent of free fatty acids, expressed as oleic acid. This ideal is seldom realized in market *ghee*. *Agmark* standards allow a free fatty acid content to the extent of 2·5 per cent. In spite of this liberal limit, market *ghee* samples often have an acidity of 8 to 10 per cent, and occasionally such high figures as 19 to 20 per cent oleic acid have also been noted. It is doubtful if *ghee* with such degree of acidity should at all be classed as *ghee* and this state of affairs is a severe reflection on all concerned. This will become all the more impressive if it is realized that *vanaspati*, a product that is considered much inferior to *ghee*, is allowed to have only 0·2 per cent of free fatty acids.

The main factors which contribute to the development of free fatty acids are undesirable micro-organisms, lipase and moisture.

Micro-organism: Certain types of micro-organisms are known to break up butter-fat rapidly. These organisms are not originally present in milk but gain access through atmospheric contamination, the use of unclean water, and unclean vessels. Having once got access to milk, curds or butter, they multiply very rapidly and secrete a substance called lipase, which is a fat-splitting enzyme. It is a common practice to use raw milk for preparing curds. This is most undesirable and accounts for nearly 50 per cent of the defects found in market *ghee*. If milk is boiled, i.e. brought to first boil and simmered for five minutes, it will destroy almost all the organisms. This milk, after cooling, should be inoculated with a good starter. A rough method of judging whether the starter is of desirable quality is to observe its consistency and flavour. Good starter, formed by the presence of lactic acid organisms, will be solid in consistency with the separation of little whey at the top of the whole mass. A bad starter will not be a solid mass, but will be in two layers, curd at the top and a thick layer of whey at the bottom, and

will be full of gas holes. A good starter added to milk brings about coagulation of milk by the development of lactic acid organisms. These organisms tend to preserve the curd against the intrusion of undesirable organisms from the atmosphere. If the milk is not boiled before curdling, there will be a large number of fat-splitting organisms and the lactic acid bacteria are unable to exercise their full prophylactic effect.

The usual type of containers used for storing milk and milk products are porous and these pores will serve as an ideal hiding place for bacteria. It is desirable that after cleaning the vessels with mud and rinsing with water, they should be sterilized by filling three-fourths with water and bringing to boil, preferably after covering the pot with a lid. Vessels not thus sterilized are a good source of contamination, especially when raw milk is kept for souring.

Lipase: The enzyme lipase is always present in milk and is known to be a great source of trouble to the dairy industry. It is soluble in *ghee* and hence if not destroyed will always be associated with *ghee* at all stages of production. The best and the easiest means of getting rid of lipase is to boil the milk as suggested. In unboiled milk this natural lipase is further augmented by the lipase produced by micro-organisms when very old or unclean culture is used for inoculating fresh milk.

Moisture: The presence of water or butter-milk increases the development of acidity in *ghee*. Butter should, therefore, be stored for as short an interval as possible. The presence of butter-milk also serves as a source for bacterial contamination. Compared to the presence of butter-milk, water alone is less harmful. It is, therefore, essential that butter should be given at least one and preferably two washings with clean water, especially if the butter is not to be melted into *ghee* at once.

The following results illustrate the development of acidity in butter and *ghee* that takes place under different conditions. For results shown in Fig. 1, *ghee* was prepared from the same batch of cow milk, a part of which was boiled and the other part used in the raw state. The curd was soured for two, four, six and eight days respectively and then churned into butter. The acidity of butter was determined and is illustrated in Fig. 1.

It will be noticed that butter made from raw milk curds develops acidity nearly two and a half times as rapidly as similar butter obtained from boiled milk curds. When this butter with initial high acidity is stored, there is a further development in the acidity as is illustrated in Fig. 2. On the other hand butter made from boiled milk shows very little acidity. This shows that much harm is done by storing butter and it should be converted to *ghee* as early as possible.

As it is necessary to boil butter to *ghee* as rapidly as necessary, it is equally necessary not to store the curds for any length of time but to quickly churn out the butter and convert the latter into *ghee*. Fig. 3 illustrates the effect of storing curds. It will be seen that with raw milk curds, the acidity in *ghee* keeps on rising the longer the curds are stored. Boiling milk initially safeguards any spoilage and *ghee* of very low acidity is obtained even if for some reasons it is found necessary to keep the curds. Thus by using boiled milk a reasonable safeguard can be provided for obtaining a good *ghee* at the end.

(B) *Development of rancidity in* ghee

Rancidity is quite a distinct phenomenon from development of acidity. A sample of *ghee* may have high rancidity but still will have low acidity. On the other hand a sample of high acid *ghee* is very likely to have high rancidity also. There are many factors which are responsible for the development of rancidity, the chief of which are air, light, heat and certain metals. Fats normally contain certain properties of resisting the onset of rancidity but once this resistance is destroyed rancidity will develop very rapidly. A sample of *ghee* with high acidity may pass unnoticed by taste and odour but development of rancidity even in initial stages, will be easily detected organoleptically. *Ghee* prepared under best conditions will develop rancidity if stored under bad conditions. *Ghee* should be kept away from *air* which contains oxygen. As far as possible use of porous pots should be avoided. Glazed pots, porcelain jars, aluminium pots, tinned containers are the best for storage. These containers are impervious both to air and light. When *ghee* is to be stored, the container should be filled right to the top so as not to leave a big air gap which will supply oxygen for the development of rancidity. Hot

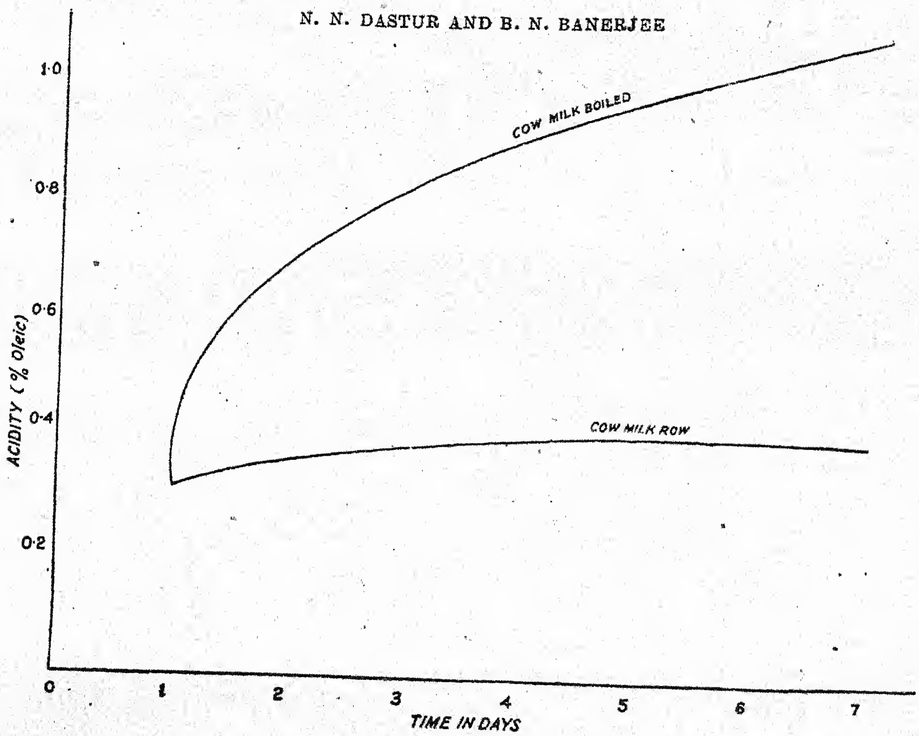


FIG. 1. The effect of using raw and boiled milks on the development of acidity in butter

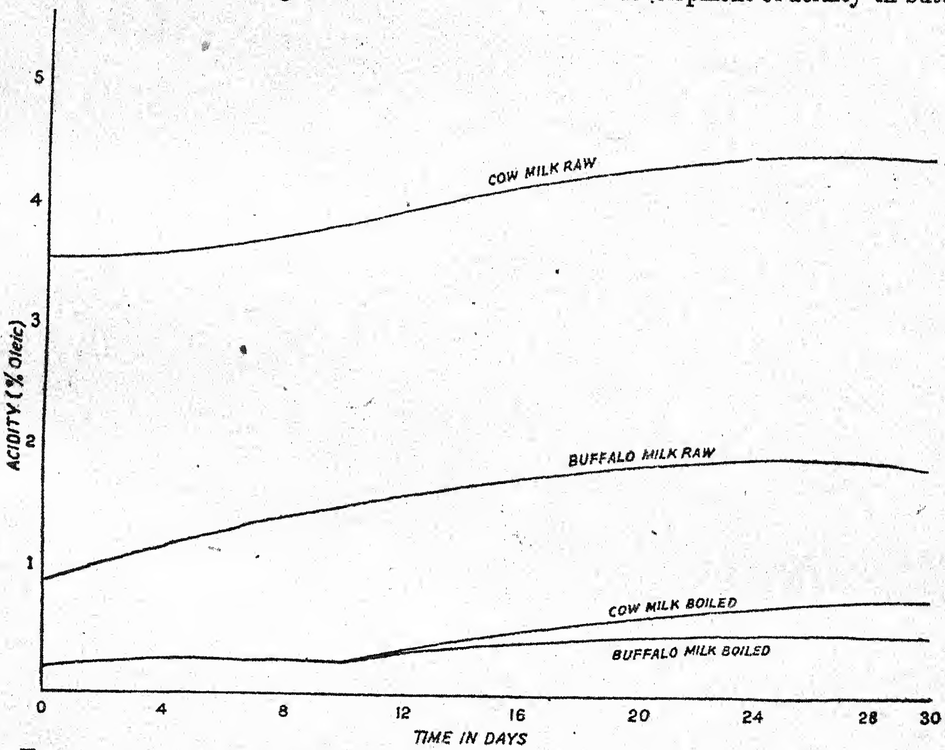


FIG. 2. The effect of storing butter on the development of acidity in *ghee*.

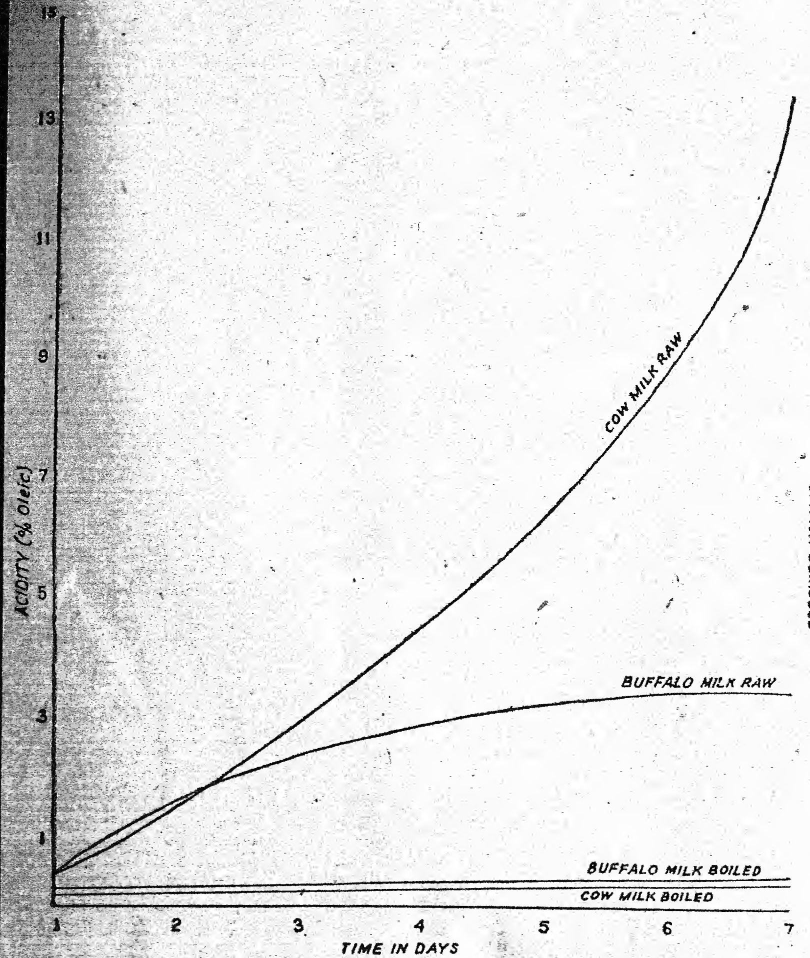


FIG. 3. The effect of storing curds on the development of acidity in *ghee*.

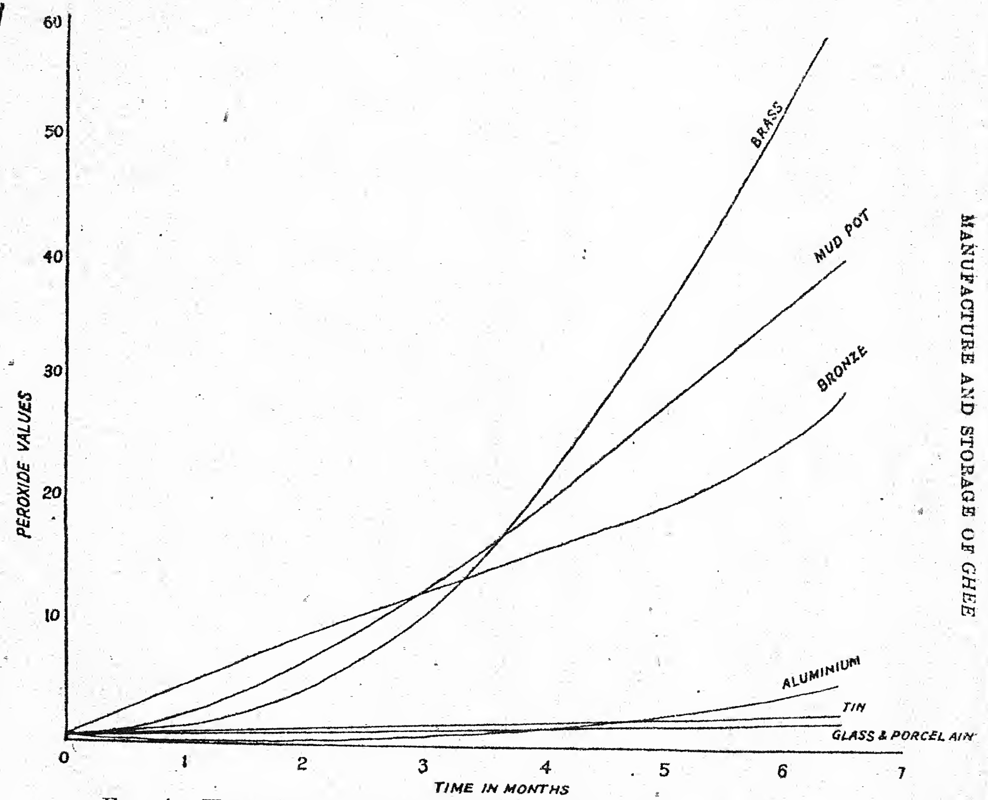


FIG. 4. Keeping quality of *ghee* stored in different containers.

ghee should not be left open exposed to air. Light is a very powerful agent in developing rancidity. Open *ghee* tins should not be kept exposed to light. The place where *ghee* is prepared or packed should be well-shaded. The action of light is rather persistent. The rancidity does not develop at once but once it has been initiated, though only in a very small measure, the *ghee* will go bad even though stored afterwards in closed containers. Certain metals act as powerful catalysts for the development of rancidity when present in very small quantities. Iron and copper are the chief amongst those which are likely to be encountered in everyday practice. Use of brass and bronze vessels which contain copper should be avoided not only for storing *ghee* but also for keeping milk which is to be used for preparing butter or *ghee*. If they are used, they should be heavily tinned. Tin cans with any rusty spots should not be used for storing *ghee* at any stage.

In Fig. 4 is shown the effect of different types of containers on the keeping quality of *ghee* stored in these as measured by the peroxide value.

It will be noticed that *ghee* stored in glass bottles, glazed porcelain jars, tin cans and aluminium vessels keeps good for a long time without showing high rancidity. The use of such containers both under household and trade conditions is recommended. A word may be added about glass. Glass, apart from being fragile, allows light to pass through and hence its use should be discouraged.

Undesirable factors in actual practice

Having studied the theoretical causes of the spoilage of *ghee*, it may be well to enumerate here from actual practice instances wherein undesirable factors do come into play. In some parts of the country raw milk is regularly used and soured in porous mud-pots with old butter-milk. All these conditions favour contamination with undesirable strains of bacteria which break up *ghee* into free fatty acids. In these circumstances *ghee* is exposed to ideal conditions to go bad and develop high acidity. Curds are sometimes churned in naked brass pots. Brass contains copper which easily goes into solution under the influence of acid contained in curds and butter-milk. This copper, though in very minute quantity, will be carried along with the *ghee* at all the subsequent stages and enhance the rate of spoilage. If churning is carried out in the open, the butter may get contaminated with dust particles which may be carrying undesirable bacteria. Further, light is a very powerful agent in developing rancidity and when churning is done in the open, butter may be unduly exposed to light. The butter in many instances is not given any washing with water. The butter-milk carried along with the butter provides a very favourable source of infection and medium for the further development of micro-organisms. Butter should always be given one or two washings with clean water. Butter obtained should not be placed very near the kitchen fire as high temperature greatly reduces the keeping quality of the *ghee* prepared.

Butter is usually melted first into *kacha ghee*. This *ghee* contains quite a good deal of butter-milk. Such *ghee*, when stored in kerosene tins, which are usually old ones, starts attacking the tin. The iron that goes in solution induces greater spoilage than copper does. In many instances the tins are not properly covered. They are plugged either with rags or covered with dry banana leaves, etc. and thus *ghee* is freely exposed to the atmospheric oxygen. *Kacha ghee* is then passed on to the village merchants. The containers used for collection also suffer from the same defects as mentioned above. Further, this *kacha ghee* when it reaches the town merchants is stored for an indefinite time till required for the market. The practice of producing *kacha ghee* requires to be discouraged; but, if at all it is produced, care should be taken to melt it and bring it up to the final stage as early as possible, i.e. within about a month. For remelting *kacha ghee*, the tins of *ghee* are kept round a fire to melt the contents which are stirred from time to time with a naked iron rod. The *ghee* is usually transferred to iron *karais*. When the day's work is over, the normal practice is to wipe out the *karais* with old gunny bags. As a result, most of these vessels have a heavy lining of old *ghee* on which new *ghee* is poured. The refined *ghee* is packed in tins which are not quite new. Sometimes in order to recover as much *ghee* as possible, the *ghee* residue is exposed to direct sunlight when, due to the heat of the sun, a little more *ghee* comes out. The *ghee* is mixed

with the amount already collected. As explained, light is a powerful auto-catalyst and once the *ghee* is exposed to light the deterioration progresses readily even after the tins are filled.

The temperature to which *ghee* is exposed before final packing varies widely. In western India it is usually melted to 70° C. and then allowed to settle for about two hours. By this process most of the moisture and other impurities will be removed. If carefully carried out, this method will no doubt give good *ghee*; and it has the added advantage of imparting lactic flavour which is liked by certain classes of people. In other parts of the country *ghee* is melted to much higher temperatures ranging from 100° to 120° C. The process of heating must be carried out slowly so as to give time for moisture to escape and the temperature should not be raised too suddenly. Sometimes it happens that heating is carried out to an excessive degree, temperature going up as high as 150°C. This is very undesirable because *ghee* loses its vitamin A content very rapidly when the temperature goes above 120°C. At 120°C. the residue at the bottom, which is composed of casein, will just begin to go brown but it should not become dark brown.

Methods of obtaining good ghee

We shall now proceed to describe how good *ghee* can be obtained by different methods. As mentioned before each method is capable of giving good *ghee* and should be selected as per facilities available. Special features of each method will be described under each method.

Desi *method:* The recovery of *ghee* by this method is not good. As high as 15 per cent of butter-fat may be left in the butter-milk. This is the most widely followed process and if the butter-milk that is produced is consumed entirely by the producers, it cannot be considered as loss. All the appliances are procurable under village conditions and the method yields a by-product the disposal of which is not a problem. This method is ideally suited for small producers but cannot be applied on a factory scale.

Milk to be used for the preparation of *ghee* should be brought to boil and simmered for five minutes. The vessel used should be clean and if mud pots are used, they should be sterilized by boiling water in them. Naked brass and bronze vessels should not be used. After the milk is cooled, a little of a good quality *dahi* should be added and the milk allowed to curdle. For getting this seed culture it is preferable not to use previous samples of *dahi* or butter-milk, but a small quantity of *dahi* should be prepared in another vessel using only boiled milk. When adding the seed care should be taken that it is compact and has agreeable odour. If there is a separation of whey at the bottom or there are gas holes, this culture should be discarded.

After allowing the curd to stand for say 24 hours, it should be churned, either in the same vessel or by transferring it to a larger vessel with the desired amount of clean water. This vessel should also be cleaned as described above. The paddles used for churning should be made from good wood and should not contain any nails or other iron connection. Butter-milk will easily take up minute quantities of metals which will react adversely on the keeping quality of *ghee*. The churning should be carried out in shade, avoiding direct sunlight as far as possible. Preferably the ground where churning is carried out should be watered to avoid contamination with dust.

The butter should not be over-churned and when ready should be given one or two washings with clean and cold water. It is advisable to convert this butter at once into *ghee*. If for some reason this cannot be done, the butter should be dipped in clean cold water and preserved in a closed vessel. The water should be changed as least once in a day. The storage period should not exceed three days at the most.

For melting butter into *ghee* a clean vessel should be selected. The stirrer should be either of aluminium or some tinned metal. It is preferable to make *pucca ghee* at once, instead of first making *kacha ghee*, and further heating it later. When it is not desired to make *pucca ghee*, butter after melting should be allowed to stand sufficiently long to allow *ghee* to separate out. When transferring *ghee* to the vessel in which it is to be stored, care should be taken not to allow any bottom aqueous layer to pass. *Ghee* should be stored in good tins, aluminium vessels or tinned brass vessels with good lids and kept in a cool place. As far as possible the vessel should be filled right to the top to give as little air space as possible. If *ghee* is required for daily use, the required quantity that will last for three or four days

should be taken out in a smaller container so that the whole bulk of *ghee* does not come in contact with air often.

Sometimes *ghee* is not directly made into *pucca* for the fear that it will lose its flavour before it is sold. This is quite true if during storage *ghee* is exposed to air, rusty spots and other destructive agencies. *Ghee* that is well-prepared and carefully stored can be preserved without any fear of rapid deterioration. Containers, in which *ghee* is stored, should not be exposed to direct sunlight.

Creamery butter method: This method is adoptable under factory conditions because the volume of products to be dealt with is small. To recover *ghee* from 100 lb. of milk containing 5 per cent fat, only 12 lb. of cream will have to be handled, whilst in the *desi* method all the 100 lb. of milk will require to be stored. The method requires special appliances like a cream separator, a butter churn, butter worker, etc. It can thus be adopted by moderately big producers and it is expected that the process will be carried out under more hygienic conditions as all the necessary facilities are available. The process yields separated milk as a by-product. This is not relished to the same extent as butter-milk by human beings. Sometimes it is given to cattle but it is also very often wasted. This separated milk contains two valuable constituents of considerable commercial value, viz. casein and lactose. Casein is sometimes recovered but the method used is so crude that the sale of the product obtained barely covers the cost of production. Lactose is not recovered. The advantage of the creamery butter process will only become evident when people learn to utilize the separated milk properly.

Fresh milk should be used for separation. For maximum efficiency the temperature of the milk should be near about that of the animal body (110° F.). The cream screw should be so adjusted as to give about 40 per cent fat in the cream. This fresh cream should be pasteurized by heating it to 145° to 160° F. and holding it at that temperature for 30 minutes and afterwards cooling it to below 45° F.; or heating it to 180° F. or above for five seconds and then quickly cooling it to 45° F. Pasteurization ensures complete destruction of all undesirable micro-organisms, thus assuring a better keeping quality both for butter and *ghee*. This cream is inoculated with a clean healthy starter as mentioned under the *desi* method and allowed to ripen for about 12 hours at 40 to 50° F. The cream is churned after diluting to the desired consistency. The butter obtained is given two washings with clean water. Over-churning and over-working should be avoided as they tend to make butter soft and 'greasy'. If cold water is used, butter with a moisture content of 16 per cent can easily be obtained. Butter to be used for making *ghee* should not be salted.

Butter obtained should be melted into *ghee* as outlined under the *desi* method above.

Cream ghee: The preparation of butter by the creamery process and then melting it to *ghee* is a lengthy process requiring extra equipment and labour. The process can be shortened, reducing the cost of production at the same time, by directly heating cream to obtain *ghee*. The method then becomes greatly simplified and can be used even by small individual producers. *Ghee* of good quality is obtained and the process may be adopted both for small and largescale production. As cream is directly melted into *ghee*, the chances of its contact with water, etc. are considerably reduced enhancing the quality thereby.

Fresh milk is separated in a cream separator adjusted to give high percentage of fat (at least 60 per cent). For ease of separation milk is heated to about 100° F. before passing through the separator. The cream obtained is diluted with twice the amount of clean water and reseparated. This reseparation helps to remove most of the casein and other impurities. This process facilitates quicker separation of the fat and also minimizes the loss of *ghee* by reducing the quantity of *matha*. The cream obtained is inoculated with a good culture and soured for 6 to 8 hours at a temperature of about 50° F. The cream is then melted into *ghee* as outlined under the *desi* method described before.

To obtain *ghee* naturally more fuel will be required but this increase in cost will be amply compensated by saving in the cost of equipment, labour charges and improved quality of *ghee*. When heating cream, the vessel used should be bigger than that normally used for melting butter as there is a tendency to foam. Heating should be carried out on a steady, non-smoky fire, with frequent stirring.

Blending of ghee: Almost all the *ghee* that is produced under village conditions is

brought to urban centres and blended. This is carried out with a view to attain three objectives : (a) to get rid of any impurity in *kacha ghee*, (b) to obtain *ghee* of a uniform quality acceptable to local market conditions and conforming to local legal specifications, and (c) to repack loose *ghee* in proper tins.

This type of work is naturally carried out by merchants with substantial means. Still it is regrettable that in most cases the work is carried out under very crude conditions and leaves scope for much improvement. The packing centres are housed in old buildings sometimes without a proper roof. Melting is carried out in big iron *karais* which are not tinned, nor cleaned with soda and water at the completion of each day's work. When the days' work is over, these are left uncovered and in the morning just wiped with some old gunny bags. When *ghee* is put in, these *karais* are never covered but are left open exposed to light with every possibility of being contaminated with dust. Bare hands are freely dipped in *ghee* to judge the temperature. Persons attending to this work are not provided with clean clothes and the nature of the work is such that clothes get soiled easily.

The tins used for packing *ghee* are not always new. They are usually used *ghee* or *vanaspati* tins which are not given a thorough washing with soda and water. After *ghee* is transferred to these, they are left overnight in the open to cool slowly.

It is thus evident that there is a considerable scope for improvement in our present methods of handling *ghee*. What is important for the *ghee* merchants is to realize that they are dealing with a very delicate product which can meet certain nutritional requirements of the nation if elementary care is exercised. It is no exaggeration to state that at present the public at large is very sceptical about the quality of market *ghee* and if this state of affairs continues they will look more and more to other sources for fats. *Ghee* is sold at a high cost and naturally the public expects it to be superior to other fats like vegetable oils and *vanaspati*. Hence every special effort should be made to carry out blending with the best quality of raw *ghee* under most hygienic conditions.

It should be insisted that *kacha ghee* also should be brought only in new tins. This *ghee* should be melted and packed for market without delay. The refining should be carried out in a specially constructed building with cement roof and floor and inlaid with white tiles on the sides. Every care should be taken to exclude flies. The room should be well-ventilated and sufficiently lighted without any sunlight entering in directly. The vessels used for melting *ghee* should be heavily tinned. For melting it is better to use steam-jacketed pans with lids. If *ghee* is to be refined by the sedimentation process, the vessels used for melting should be preferably of a cylindrical shape with a tap about six inches away from the bottom. After melting, *ghee* should be maintained for 2 to 3 hours at 60°C. to allow all moisture to settle out. If *ghee* is recovered by the boiling process, shallower pans will be more convenient as they allow the moisture to escape rapidly. The temperature of boiling should never exceed 115° C. A tap should be provided three inches away from the bottom; and the residue settles down below this level when the *ghee* is allowed to cool. This *ghee* should be then filled directly into new tins which have been given a good washing with soda and water. After filling the tins to a height of about six-eighth, loose lids should be put and the mass allowed to cool down over-night. Next day fresh *ghee* should be added to fill the tins completely and then they should be soldered. These tins should then be stored in a cool place. It is advisable to have special rooms for this purpose which can be maintained at a lower temperature. The present practice of marketing *ghee* only in bulk packings should be extended by the use of smaller packs so that *ghee* is not sold loose and is thus protected completely from the time it leaves the refinery till it reaches the consumers. As a means of guiding the public it would be better if the *ghee* trade by common consent uses tins of a particular shape, say rectangular, which may be easily distinguished from the tins used for selling other edible fats.

In India there are a few refineries which do tend to approach the ideal conditions laid down above. What is now required is the multiplication of such places all over the country. It is hoped that at no distant future, before licensing a *ghee* packing station, it will be insisted that it fulfils certain minimum requirements.

The illustrations inserted (Figs. 5-8) have been taken from one such modern factory. Fig. 5 demonstrates the arrangements for

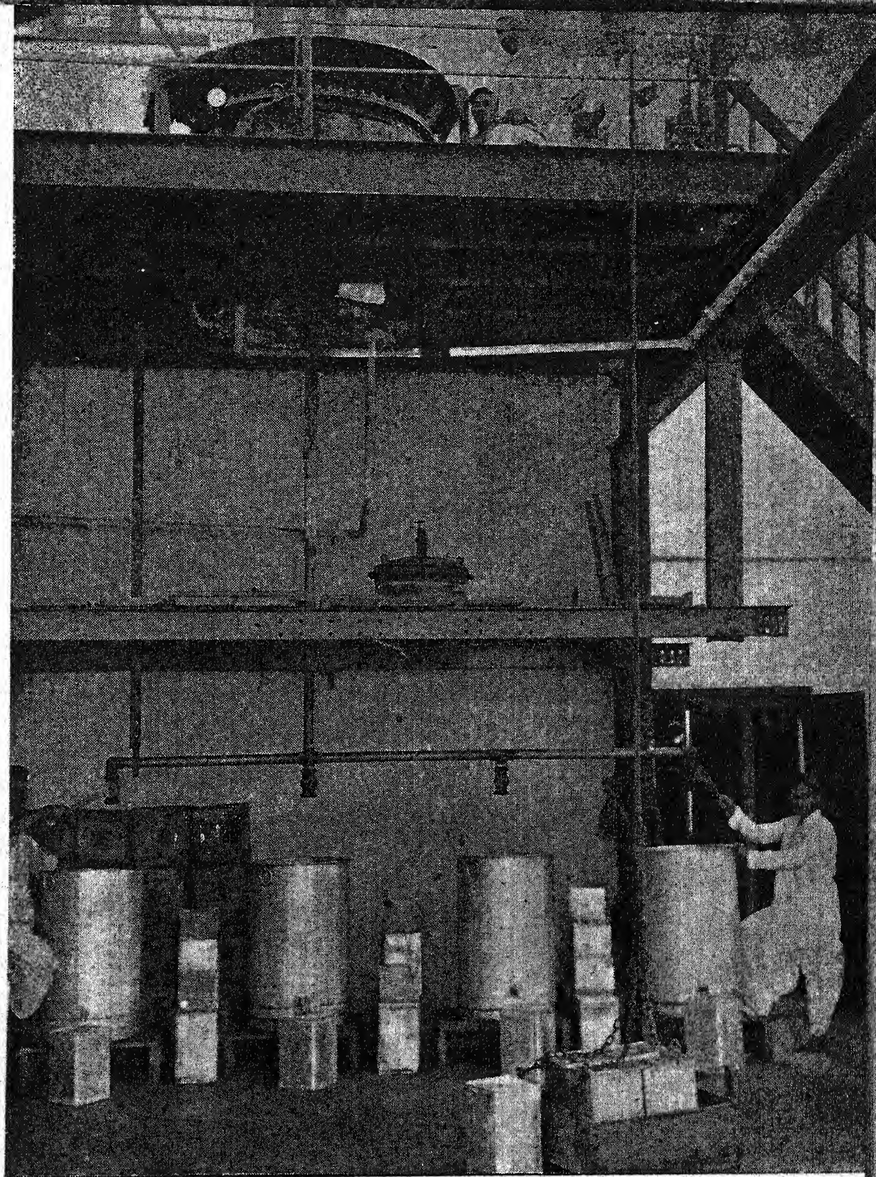


Fig. 5. Arrangement for melting *ghee*.

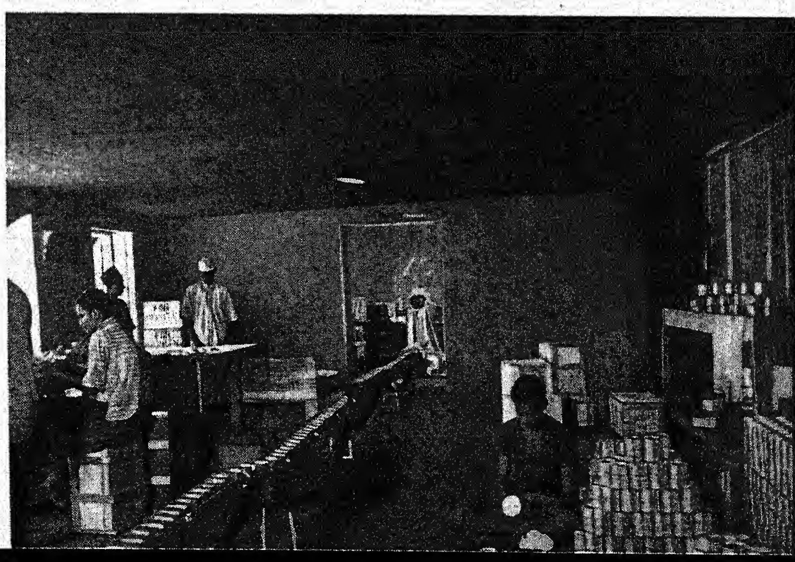


Fig. 6. An assembly line for packing butter tins.

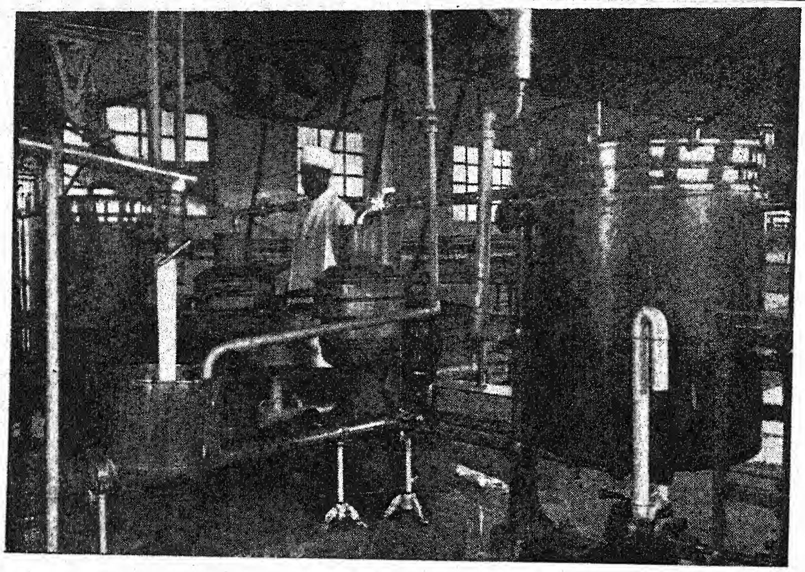


FIG. 7. Direct cream process as worked under factory conditions.

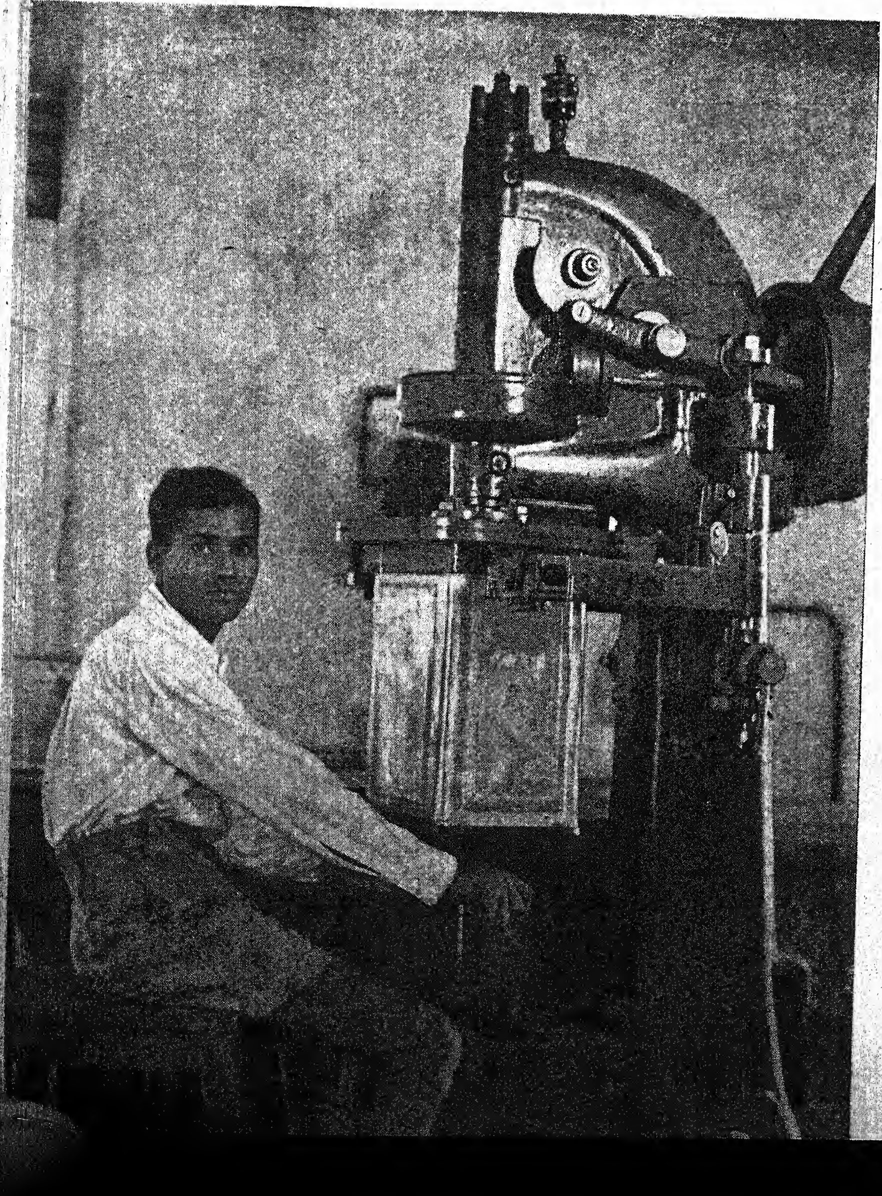


FIG. 8. A seaming machine in action.

melting *ghee*; heating is carried out by steam and then *ghee* is allowed to flow by gravity into settling tanks. The tanks are heavily tinned. From these tanks *ghee* flows directly into tins. The whole building is made of concrete thus ensuring ease of cleaning.

Fig. 6 shows a seaming machine in action; by the use of such machines any possibility of hand contact is avoided. Now-a-days cheap small hand-seaming machines are available which can be used for packing tins of smaller sizes. Fig. 7 shows an assembly line for packing butter tins. Similar arrangement for small packs of *ghee* will mean rapid and clean work. Fig. 8 shows how the direct cream process can be worked under factory conditions for obtaining *ghee*; it illustrates a series of milk separators. The thick cream obtained can be heated directly in open pans or under closed vacuum pans. The system of heating cream or butter under vacuum to obtain *ghee* has recently been developed in New Zealand and Australia and the process can be applied under Indian conditions without any difficulty. It is desirable to develop factory method of producing *ghee*, starting from the initial cream or even milk stage. This alone will ensure an uniformly high quality for the product and incidently lower the cost of production.

From the text it will be evident that the preparation of good *ghee* does not require very special skill. Use of plain common sense will solve nearly half the troubles encountered at present before *ghee* is finally put on the market. The first essential is cleanliness in the method of preparation and storage. The second essential is protection against the destructive action of air, light, water and micro-organisms. Both these can be achieved by simple means as explained before if everybody concerned is willing to play his or her part. Every care should be taken in the preparation of a product like *ghee*, which is so highly prized by all consumers and which gives good returns to the producers. Preparation of good *ghee* is so simple that the same results can be obtained both by small producers as well as largescale factory owners.

When describing the methods of preparation of *ghee*, a word about its adulteration will not be out of place. Natural *ghee* no doubt varies a great deal in its composition and hence people are tempted to resort to adulteration. The methods of detecting adulteration have now been so perfected that adulteration even with 5 per cent of vegetable oils and *vanaspati* can easily be detected. With such sensitive methods available for detection any resort to malpractices undermines the confidence of the public and should never be resorted to.

In the past great importance has been attached to such physical properties as grain structure or colour or flavour of *ghee*. These properties have no doubt their value as giving a quick indication of the quality but they should never be regarded as the sole criteria, as they are subject to artificial manipulation. *Ghee* enjoys superiority over most of the other natural fats because of its vitamin A and carotene content. In no other respect has *ghee* been proved to be superior to other common edible fats. Hence, it is to be expected that *ghee* coming to the market and when delivered to the consumers should have a minimum quantity of vitamin A content. Unfortunately our present legal standards do not take into account this important nutritive property of *ghee*, but it is suggested that the *ghee* trade itself should take a lead in the matter to assure the consumers the quality of their product. A minimum quantity of vitamin that should be present in *ghee* should be laid down. The presence of natural vitamin A will also assure that the *ghee* has been prepared and stored under proper conditions and is fresh. Now-a-days artificial products like margarine are expected to contain a specified amount of vitamins A and D and so the above proposal cannot be regarded as too severe. On the other hand most of the samples of *ghee* bought in the market hardly contain any vitamin A.

It has also been reported that the development of acidity in *ghee* is a controllable factor. There is, therefore, no justification for any high acid *ghee* appearing on the market. It is preferable that normally *ghee* should not contain more than 1 per cent oleic acid, but in exceptional cases this may be extended to 2 per cent. The present tendency of allowing a liberal margin for free fatty acids is to be deprecated: there is no justification for such lax standards.

The composition of *ghee* can be varied by several factors. The most important of these is feed. By adjusting the quantity and quality of food of the animals, *ghee* of any desired consistency can be produced. It is well-known that during certain seasons of the year *ghee*

produced in certain areas shows wide fluctuations in composition. This is attributable to feed. It is customary to feed oilseeds or oilcakes when available in very excessive amounts and this upsets the normal composition of secreted fat. *Ghee* obtained from such sources fails to come up to legal specifications and as a remedy it is customary to allow special grades for different areas. This opens up possibilities of adulteration by unscrupulous dealers. The best course would be to teach the primary producers to balance the feed given to the cattle all round the year. Then only *ghee* of uniform quality will be produced without any difficulty. If *ghee* below standard legal specifications is produced, it would be in the interest of everybody concerned to restrict its sale to the particular area of production. It would be best, however, to undertake all measures to avoid the production of such *ghee*.

Finally, 'dos' and 'don'ts' about good *ghee* production are summarized below :

1. Use only boiled milk.
2. Use clean vessels for storing milk, butter and *ghee*.
3. Use a clean, healthy starter.
4. Always wash the butter with clean water to remove butter-milk.
5. Do not make *kacha ghee*. Remove all moisture and *matha* from *ghee* before storing.
6. Store *ghee* in new tins, porcelain jars or aluminium containers.
7. Do not use naked iron vessels for heating *ghee*.
8. Do not leave a big air-gap in the container when storing *ghee*.
9. Do not expose *ghee* to direct sunlight.
10. Keep *ghee* containers tightly sealed.
11. Where possible, make *ghee* directly from cream.
12. Do not adulterate your *ghee*. It can be easily detected. You will be the loser in the long run.
13. Make the best possible *ghee*. Cooperate and demand a just price.
14. Science is at your service and make the best use of what knowledge is already available.

EVERLASTING BUTTER

A BUTTER that will keep indefinitely without refrigeration has been developed by the Australian Council for Scientific Research, working with the Queensland Dairy Board.

Research workers decided that butter goes bad because of microscopic cavities which hold water. The new process yields a butter fat almost devoid of moisture. The mixture contains a little casein and neutral nut oil, and a highly purified salt. It is made into 'normal butter of excellent quality' by adding one-fifth of its volume of water.

The Queensland dairy industry expects a considerable demand for the new butter for use aboard ships, and for export throughout the Far East.—*Agricultural Newsletter*, No. AGN/195.

INCREASING POTATO PRODUCTION

By PUSHKARNATH

PERHAPS at no period in the history of a country are problems of economic application, especially those connected with greater food production, more important than at the time of national emergency. India finds herself to-day in the state of national emergency when every ounce of food counts. Potato is the crop, which if given due attention, can contribute to bridge over this anxious period of food scarcity. This humble tuber has attained the foremost place in the dietary of the Western nations. 'France will thank you sometime hence because you have found bread for the poor'. These were the words of King Louis XVI for Parmentier who is credited to have discovered this new food crop in France. Germany has to thank the great famine of 1771-72 that brought potato in the fore-front in her domestic economy and to-day Germany without potatoes cannot exist. Potato competes with maize and other cereals as regards its nutritive value. Unfortunately in India potato has not yet received due recognition as an important food crop and has hitherto been regarded as a vegetable—a luxury chiefly for the town-dwellers.

High nutritive value

Potato has high nutritive value. Its carbohydrate content, reckoned on dry weight basis, is about the same as that of white bread. The protein content is lower but its quality is high. It is also a rich source of vitamin C and contains vitamin B_1.

TABLE I

Composition of potatoes and white bread

	Percentage of protein		Percentage of carbohydrate		Calories per 100 grams	
	dry	fresh	dry	fresh	dry	fresh
Peeled and boiled potatoes	6·6	1·3	98	19·7	435	87
White bread	10·6	7·2	79	54·0	382	260

PUSHKARNATH, M.Sc. (HONS.), PH.D., ASSOC. I.A.R.I., is Superintendent and Potato Research Officer, Potato and Wheat Breeding Station, Simla.

High yield and wide adaptability

Potato is potentially a heavy yielding crop plant. Even under present neglected conditions the potato crop yields, on an average, over 100 maunds to an acre and about three times more calories of food per acre than any cereal crop.

Potato is a crop which is adapted to a wide and often diverse range of climatic conditions. In India it is grown from near about the sea-level to a height of over 9,000 ft. up on the Himalayan slopes. It is grown in long summer days in the hills and short winter days in plains. In many tracts in the plains two crops of potatoes are raised within a short period of about six months and at some places, as in the Nilgiri Hills, where winter is not very severe, three different crops can be grown in a year. It is a crop which responds liberally to cultural and manurial treatments. The potentiality of this crop has not yet been fully exploited.

Our immediate needs

Our immediate needs are two-fold, namely to make the potato crop popular and to produce more. Our pre-war consumption *per capita*, per annum, was about 9 lb. compared to about 440 lb. of Germany. In India there is a great scope for making potato more popular. There is no serious prejudice, as was the case in earlier periods in the several Western countries, against this crop. Unlike the Wesern countries, where potato is familiar mostly in the form of baked and boiled potatoes or as chips, the Indian housewife knows to serve it in a variety of ways. Mashed potato if mixed with wheat flour gives excellent *chapatties*. If it could be had at a cheap price there seems to be no reason why people will not eat it in larger quantities and appreciate the value of this useful tuber as an article of food.

Increase in production and thereby cheapening the price is linked with several problems, both agricultural and otherwise. Here, however, only practical means of increasing the production of potatoes, within a reasonable time, need be mentioned. With the adoption of the

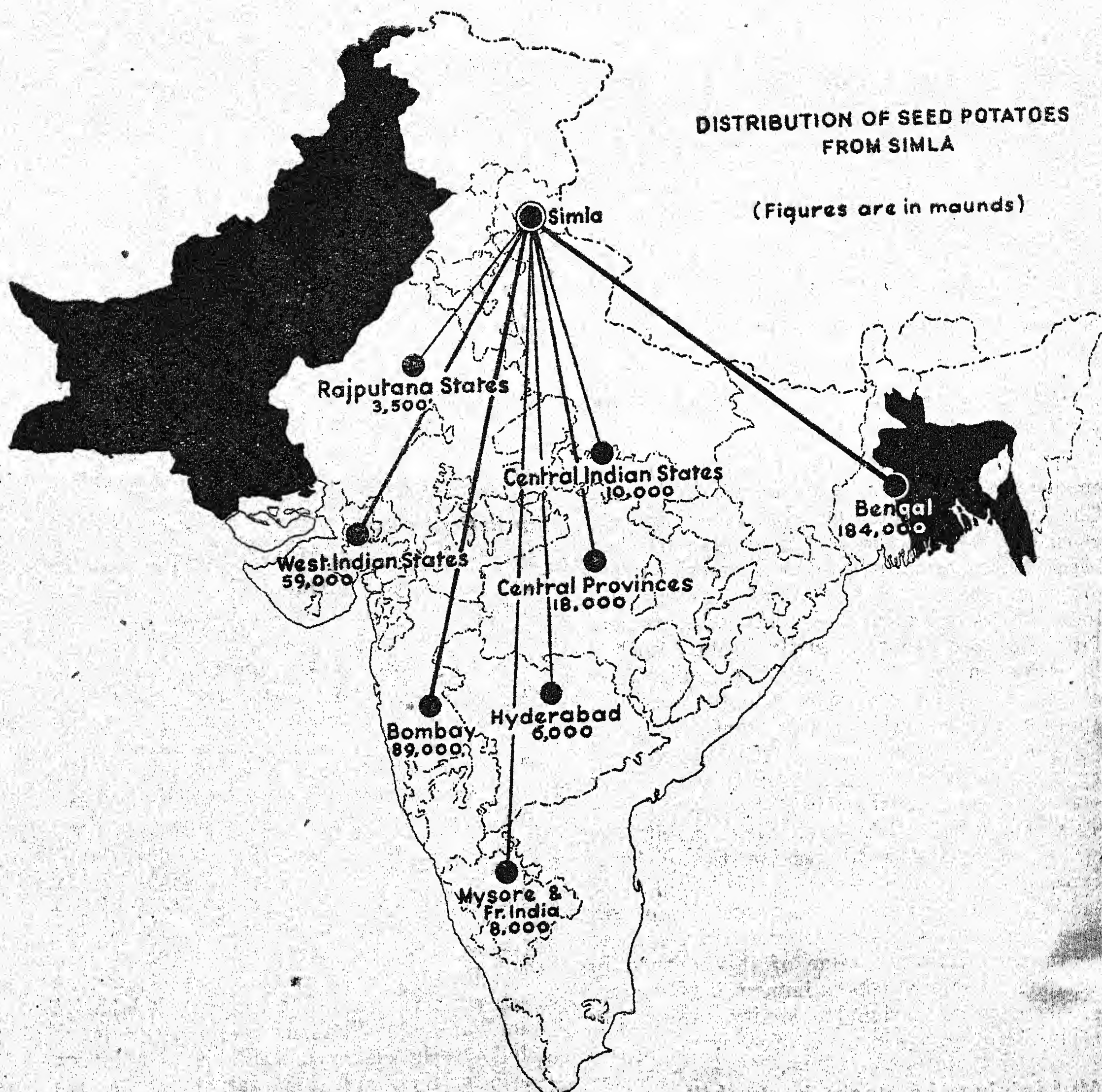

DISTRIBUTION OF SEED POTATOES
FROM SIMLA
(Figures are in maunds)
Simla
Rajputana States
3,500
Central Indian States
10,000
Bengal
184,000
West Indian States
59,000
Central Provinces
18,000
Bombay
89,000
Hyderabad
6,000
Mysore &
Fr. India
8,000

TABLE III

Approximate requirements of provinces/States for potatoes

Province	Table use	Seed stocks	Total
1. Delhi	22,500	Nil	22,500
2. United Provinces ..	49,000	Nil	49,000
3. Bihar ..	34,000	Nil	34,000
4. Central Provinces ..	8,500	18,000	26,500
5. Bombay ..	11,500	89,000	100,500
6. Rajputana States ..	4,000	3,500	7,500
7. States of Western India	Nil	59,000	59,000
8. Central India States ..	Nil	10,000	10,000
9. Hyderabad	Nil	6,000	6,000
10. Mysore and French India	Nil	8,000	8,000
11. Bengal ..	36,000	184,000	220,000
Total ..	165,500	377,500	543,000

Simla is an important seed-potato tract from an all-India point of view. Simla seed-potatoes find their way far and wide throughout India. There is an organized trade and reasonably well-worked out system of distribution. Simla possesses all the virtues necessary for seed-potato production. Multiplication of healthy seed-stock should, therefore, start at Simla and Kumaon or Dehra Dun Hills and later extended to other tracts. A small scheme could also be initiated in the Nilgiri Hills which though having only a local interest uses a type of potato very different from the North Indian types. If through careful planning we could only succeed in replacing the existing degenerated types, the result will be beneficial and far-reaching.

Once the seed-stocks of better types have been built up and made available to the public there are great possibilities for private enterprise. Establishment on scientific lines of agencies or seed-potato growers' associations will not only help in building up and distribution of healthy seed-stocks but also act as recognized concerns for assemblage and distribution of seed-potatoes. It is a new and a profitable industry full of promise and far-reaching possibilities.

Conclusion

By virtue of its high yield, its high nutritive value, wide genetic variability, adaptability to wide and varied range of climatic conditions and rapid response to cultural and manurial treatments, there can be no doubt about the value of potato as a food crop for our present starving millions.

FOR a crop of radish the field has to be ploughed sixty times, for a crop of cotton thirty times and for a crop of paddy fifteen times and then alone fortune is assured to the cultivator.—*Agricultural aphorism from Orissa.*

SUBSTITUTE POULTRY FEEDS

By D. PARTHASARATHY

DURING the past few years, there has been an increased demand for protective foods like eggs and meat mainly due to the conditions created by the war. The people are becoming more nutrition-minded and there is a growing appreciation of the importance of eggs and meat in the dietary of the people. But the raw materials from which these protective foods could be manufactured, e.g. cereals, their by-products, etc. have also been in short supply, thereby complicating the problem. The prices of grains and other related products have soared up very high, some of them being not available at all for feeding poultry. From a knowledge of poultry nutrition, suitable substitute feedstuffs should be computed from materials which are relatively abundant, cost less and are nearly as nutritive as their original counterparts. The wisdom of feeding costly feeds, like grain, their by-products and other concentrates to the poultry has been questioned. But the hen is one of the most effective of food processors. The feed it takes, after a process of selection and concentration, comes out neatly packaged with protein of high biological value and a good percentage of protective minerals and vitamins.

Poultry ration

During normal times the poultry ration consists of mash or grain or both and supplements of protein, vitamins and minerals. The mash consists of maize-meal, wheat-bran, rice-bran, ground oats, ground barley, etc. The grain ration consists of combinations of some of the following: *Cheena*, *bajra*, cracked yellow maize, yellow maize, paddy, wheat, oats, barley, *jowar*, etc.; the supplements consist of meat-meal, fish-meal, skimmed milk, bone-meal, limestone, salt, greens, etc.

Feeding substitutes

In the feeding of substitute feeds, the first step is to change from intensive or semi-intensive systems to free range system, so that lack of any essential nutrients in the feed is offset by grassland, and the insects, worms and other live objects available on it. The second step is to divert as far as possible all portions of home-grown feeds which are not meant for human consumption and other waste products, viz. cabbage leaves, cauliflower leaves, carrot tops, and kitchen wastes, etc. In effecting such substitution only growing and laying rations should be altered, leaving the chick rations to conform as far as possible to the normal standard, for the growers and layers have greater powers of adaptability to the changed feeds without much detriment. Besides the quantity of food consumed by the chickens up to eight weeks of age is not much to warrant economy by substitution. The first few weeks of a chick's life constitute a critical period so far as the metabolism of protein and certain vitamins specially vitamin-A are concerned; and a well-balanced ration during this period will secure a better growth than otherwise.

D. PARTHASARATHY, M.Sc., is on the Staff of the Poultry Research Section, Indian Veterinary Research Institute, Mukteswar.

Substitutions in the ration

The following are some of the more important substitutes in poultry-feeding as determined by experiments conducted to-date both in India and abroad. Crushed oats may be available and can form up to 20 per cent of the feed. It is very beneficial and is a good source of iron. If not available, ground barley may replace ground oats weight for weight. Once the birds get accustomed to it, properly ground barley is as much relished by them as any other grain. Barley-meal can be used in fattening mashes. Yellow maize is an important item in poultry feeding noted for its easy digestibility and is a carbohydrate food. It also has vitamin-A activity due to its cryptoxanthin content. Some of the possible substitutes for yellow maize-meal are ground oats, ground barley, ground millets or mixtures of these. As these have little vitamin-A activity, it is advisable to supplement them with alfalfa

or lucerne-meal. In localities where the cost is no deterrent boiled potatoes can successfully replace yellow maize-meal up to 25 per cent in the ration, for on a dry matter basis the percentage composition of potatoes is nearly the same as that of yellow maize. It has also been shown that the feeding value is greatly enhanced by boiling the potatoes as the digestibility of starch and protein has been found to increase with boiling. It is contended by some that production might be affected if potatoes exceed 40 per cent of the mash. Sweet potato-meal can be used up to 20 to 25 per cent of mash mixture and can replace carbohydrate feeds in the ration. Wheat and its by-products which possess a high feeding value for poultry cannot be spared in these days of food shortage as a poultry-feed. Experiments conducted at the Indian Veterinary Research Institute, Izatnagar, and elsewhere have revealed that *bajra* has a feeding value akin to wheat and the small size of the grain renders it suitable as a chick grain also. In Cambridge, it has been found that sunflower seeds also have an equal, if not more, feeding value as wheat. Wheat bran or rice bran forms an important constituent of the mash and lack of these gives rise to many a disorder. Wheat bran is a good source of some vitamins, viz. vitamin B, pantothenic acid, the growth-promoting factor. It is also a good source of some minerals, specially manganese. It is really a difficult problem to find out suitable substitutes for wheat bran without adversely affecting the nutritive value of the ration. Ground wheat, cocoanut-meal up to 25 per cent, and palm-kernel-meal are among the substitutes suggested, if available.

Other substitutes

Other grain substitutes to replace the more important cereals are *jowar*, *cheena* and ragi. Experiments conducted at the Indian Veterinary Research Institute, Izatnagar, indicate that *jowar* and *cheena*, particularly the latter, do not rank high in their nutritive value, although as a chick grain *cheena* is very well-relished. Ragi, a popular grain in South India, has been found to be very beneficial in poultry-feeding because of its high palatability and small size. These grains, when ground, can be incorporated in the mash also. In compounding a poultry ration it is a wise practice to have a mixture of several grains to insure against a deficiency of the so-called amino-acids.

Supplements

As regards the supplements, protein is the most important and expensive. Animal protein is considered superior to vegetable protein and experience has shown that 20 to 40 per cent of the protein must come from animal sources if beneficial results are to be attained; but it is very difficult to obtain animal protein these days. Meat offals (intestines from the slaughter-house) can replace the rather costly meat-meal or fish-meal. Separated milk is an ideal protein supplement but for its cost. Butter-milk or whey or even meat offals have been found to approximate milk in feeding value. In general, the beneficial value of animal protein supplements is due to the completeness of their amino-acids, the so-called 'bricks' out of which the proteins are built up, while the vegetable proteins often lack some of these. Incidentally, animal products serve as good sources of minerals and vitamins as well. Nevertheless, good growth and good egg-production can still be obtained on diets, a large portion of which comes from vegetable sources, provided the ration is balanced in respect of vitamins and minerals whose importance cannot be underestimated.

Among the vegetable protein supplements, the important ones are, soyabean-meal, groundnut-meal, sesame-meal (*thill*), and peanut-meal. Soyabean-meal has been found to be an excellent protein supplement. Its efficiency can be considerably improved by proper processing. A combination of soyabean-meal with a minimum of animal protein such as milk makes an ideal protein supplement. It is claimed by some workers that nearly as good growth can be obtained with soyabean-meal supplement as with separated milk as a protein supplement. Groundnut-meal *plus* salt can be an effective substitute for milk or meat offals as regards rate of growth, general health, rapidity of sexual maturity and efficiency of food utilization. Soyabean-meal and groundnut-meal have been found to be almost of equal value as protein supplements in the rations of chicks, although for egg-production they have not been found to be quite as good. Sesame-meal has been found to contain all the essential amino-acids for the chick but one, and hence can be used

with other feeds, when the deficiency is likely to be compensated. Peas and peanut-meal are valuable supplements to fall back on in times of emergency. Experiments have indicated that at least 50 per cent of the more expensive animal protein concentrates can be replaced with peanut-meal. The supplementary value of pea-meal to the protein of a cereal basal diet consisting of wheat, maize, wheat bran, and oats has been found to be half of the value of casein. Undergrade groundnuts can successfully replace up to 28 per cent of the ration of growing chickens and 3·5 lb. of groundnuts can replace 1 lb. of fish-meal. It is advisable to add to these a small amount of skimmed milk. Cottonseed-meal may be used with advantage in laying mashes for egg-production but the only drawback is that the eggs after storage develop a dark colour in the yolk rendering them unfit for sale. The use of cowpeas in poultry-feeding gave encouraging results. Cowpea hay can replace lucerne-meal, the green plant serving as a green food also. In growing and laying rations cowpea-meal at 15 per cent level can be used as a partial substitute for meat or fish-meal. Baking of cowpeas considerably increases their nutritive value. It is advisable to supplement these vegetable proteins with a proper mineral mixture.

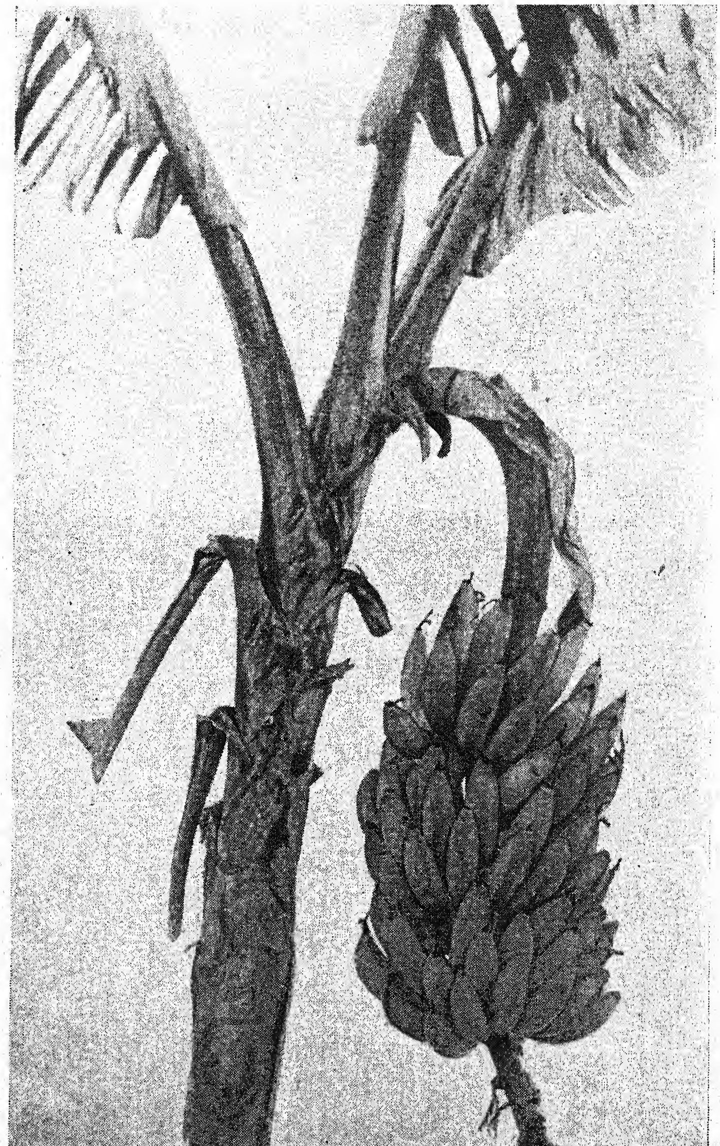
Green feeds

Green feeds serve not only as vitamin supplements but also effect a considerable saving in the consumption of mash. Mustard leaves can be the mainstay if other green feeds like berseem and lucerne are not procurable. Cabbage leaves, cauliflower leaves, carrot tops, radish tops and spinach serve as good green feeds. Silage used for cattle can also be given to poultry with advantage, although it is a moot point how far it would effect any saving in the mash. However, during periods of acute shortage this can be a good stand-by. The value of good poultry pastures is considerable. They not only effect a saving of about 5 to 10 per cent of the total feed consumption but in their presence, only smaller amounts of the critical ingredients like milk products, alfalfa and animal protein concentrates need be used. On good pasture favourable results have been obtained with growers and layers by feeding a ration of cereals, minerals and vegetable protein concentrates.

Waste products

Among the miscellaneous class of feeds, on which much work has not been done but which promise to be good substitutes, are kitchen wastes which can be fed up to half of the daily consumption and *chuni* (the outer husk of some pulses), a concentrated form of some vitamins and minerals.

Though the substitutes mentioned above are numerous, it may be emphasized that no single ration comprising these substitutes can be recommended as applicable for the whole of India. The extent to which these substitutes will be of permanent value to the poultry-keeper largely depends on their price and availability.



Gros Michel: A new banana for India.

PLATE 21

A NEW BANANA FOR INDIA

By K. CHERIAN JACOB

GROS Michel is the variety of banana which is extensively grown in the West Indies and shipped to Europe and America in large quantities in specially fitted and air-conditioned steamers. The home of this banana is said to be somewhere in the Far East, viz. Siam, Java or Malaya. It is known in Malaya as *Pisang emben*, Siam as *Klui hom*, Burma as *Thihmwe* and Ceylon as *Anamalu*. Strange enough, it is not found in South India which is the home of many varieties of banana. Two strains of this variety, one from Honolulu (Hawaii) under the name Blue Field, and the other from Trinidad (West Indies) under the name Gros Michel, were obtained and tried in the banana plot attached to the Agricultural Research Institute, Coimbatore. Both proved to be same when grown at Coimbatore. The bunches are large with 7 to 9 hands and each hand with 16 to 20 fruits, each 7 in. long. The bunch is very compact and the fruits are fairly strongly attached to the pedicel. The pulp is very sweet with excellent flavour and at flecked stage it actually 'melts' in the mouth. It is an excellent dessert banana. It thrives well under all conditions of soil and climate up to an elevation of 4,500 ft. It is a good banana both for export and home use.

Breeding out superior clones in banana has not yet been a great success. Bud sports of superior clones are quite a common occurrence in this crop. The easiest method of improvement of banana, therefore, is by the trial of all the best known banana varieties in a suitable place and distributing them after acclimatization and multiplication. Gros Michel is an ideal variety for trial. A few suckers may be available for distribution with the Superintendent, Central Farm, Coimbatore.

EFFECT OF *JOWAR* AND MAIZE ON SUCCEEDING CROPS

FROM experiments conducted at Indian Agricultural Research Institute, New Delhi, to ascertain the extent to which the crop yields are effected after maize has been grown, it was found that the yields of wheat were reduced by 16·87 per cent in 1938-39 and by 37 per cent in 1939-40, when compared with the yields after fallow. From Table I, showing the average yield data of five years (1930-31 to 1934-35), it is clear that in the first experiment an increase of 18·6 per cent in the yield of wheat after maize and *urad* mixed crop was obtained as compared to that of wheat after maize. Further from the second experiment cited in the same Table showing the average yield of five years (1930-31 to 1934-35), it can be seen that there was an increase of 14·4 per cent in the yield of maize after barley and *kerao* (legume) mixed crop as compared to that of maize after barley. The differences in yields are negligible for some years.

TABLE I

Pusa experiments on the yield of wheat and maize

1st Experiment

Year		Yield of wheat after maize Maunds	Yield of wheat after maize and *urad* mixed Maunds
1931	.. ..	9·6	10·6
1932	.. ..	6·5	9·3
1933	.. ..	11·5	11·8
1934	.. ..	11·5	14·1
1935	.. ..	6·5	8·1
Average	..	9·1	10·8

Increase over wheat after maize 18·6 per cent

2nd Experiment

Year		Yield of maize after barley Maunds	Yield of maize after barley and *kerao* mixed Maunds
1930–31	..	9·8	9·9
1931–32	..	6·3	7·0
1932–33	..	16·4	20·7
1933–34	..	9·2	9·4
1934–35	..	10·5	12·5
Average	..	10·4	11·9

Increase over maize after barley 14·4 per cent

When the interval between the two operations was increased from the normal period of 36 days to 51 days, the yield was increased by 51 per cent and when the interval was 78 days, the increase in yield was 52·8 per cent. The following data of Burt* show similar effect of increase in interval in the United Provinces on the yield of wheat that followed *jowar* (Table II).

TABLE II

Effect of increase in interval of yield of wheat after jowar

		Yield of wheat
Jowar removed and land ploughed on	28 August (63 days)	20·8 maunds
,,	8 Sept. (52 days)	13·5 ,,
,,	16 Sept. (44 days)	11·7 ,,

Wheat was sown on 30 October

From experiments at Nagpur it was seen that the yield of wheat after *jowar* fodder was lower than that of wheat after fallow.

*Burt B. C., *Agril. J. India*. 12, 538-539.

Further the yield of wheat after *jowar* and *tur* (legume) mixed crop was greater than that of wheat after wheat in the years 1890-91 to 1894-95.

The experiments in Madras Presidency showed that the yield of cotton after *jowar* is less than that of cotton after *bajra*, while there was no appreciable difference between the yield of chillies, tobacco or *jowar* after *jowar* and the yields of the same crop after *bajra*.

Results from Kanpur indicated that the yield of wheat after *jowar* fodder was lower than that of wheat after fallow.

The harmful effects of these two crops on the succeeding crops appear to be due to the following reasons :

(1) Toxin or toxins secreted by the roots of the crops, which seem very unstable because they have so far defied chemical isolation, might directly injure the roots of the succeeding crops.

(2) The toxin might also check bacterial action, reduce carbon-dioxide production and defloculate the soil by altering the equilibrium between sodium and calcium.

(3) There is experimental evidence to indicate the possibility of a detrimental effect of maize secretion on nitrifying organisms. It appears that nitrogen starvation is caused at an early stage of the growth of wheat succeeding maize ; this is ultimately reflected on the final yield of wheat. The harmful effects can, however, be overcome by aeration or use of calcium carbonate, ferric hydrate or manganese-dioxide.

(4) The growing of *jowar* disturbed the sodium content of a soil. The soil was left more alkaline at the time of sowing cotton than the soil in which *bajra* was grown as a previous crop in Madras Presidency.

(5) Experiments at Padegaon showed that cotton and *jowar* build up water-stable structure during their growth period which persisted even after the harvest of these crops.

Considering the above evidence it appears that the after-effect of maize or *jowar* is interference in some way or other with process of enrichment of total and available nitrogen in the soil and can at least be partially overcome among other method by

(i) including a legume in the rotation,

(ii) increasing the interval between the two cereals *maize* or *jowar*, and *wheat* or *barley*, and

(iii) applying heavy doses of a mixture of organic and inorganic nitrogenous manures.

The one important point is that the problem arises as a result of bad farming systems and it may cease to be when methods of cropping and crop management, which restore soil fertility of stable type, are introduced. (I.A.R.I.).

You ask We answer

Enquiries regarding agriculture and animal husbandry shoud be addressed to the Directors of Agriculture and Veterinary Services in provinces and States. This section is reserved for replies to selected letters in cases where it seems that the information may be of general interest.

Q. Is Brucellosis a serious disease in India? What economic losses are caused by it and how can it be eradicated?

A. Brucellosis, commonly referred to as contagious abortion or Bang's disease is responsible for causing heavy losses to the livestock industry of this country. The disease occurs in India in form of epidemics, endemics and flare-ups of endemics. Zebu and buffaloes are comparatively less susceptible than the imported pure-breds or European-zebu crosses. Its annual incidence in this country is commonly from 1 to 5 per cent of the breeding stock, though not infrequently 5 to 15 per cent incidence is recorded. More commonly the disease occurs in the humid tracts of the south-east where the infection appears to be indigenous, while in the desert tracts of the north-west the disease is comparatively rare. In organized farms imported infection is present irrespective of its situation.

This disease causes significant economic losses, as we lose in way of calf that is born dead or is weak and soon dies, the diminished production of milk in dairy animals, the temporary or permanent sterility that may follow the infection and not infrequently the loss of the cow itself through infection. The breeder may also suffer financial losses due to interference in the breeding programme when the disease is present in the herd. Among the working bullocks this disease is the major cause of synovitis and results in tremendous loss of working capacity in the affected animals.

In desert areas factors responsible for the limitation of the spread of Brucellosis are abundant sunshine, dryness, dispersion of cattle and simple hygiene. Reverse conditions such as lack of sunshine, humidity, congestion and lack of hygiene increase the incidence of the disease in humid areas.

There is no drug, chemical or medicinal compound, that has proved effective in prevention or cure of brucellosis. In dry and desert areas the disease can be easily controlled by educating the cattle-owners to practise open-air hygienic farming. But in humid areas, vaccination of the animals with a single dose of 5 c.c. of the Brucella vaccine can be done with very encouraging results. The subjects for vaccination are empty females, virgin heifers shortly before service is anticipated or 4 to 8 months old calves. Heifer vaccination is preferred. The vaccine can be obtained from the Indian Veterinary Research Institute, Mukteswar. If possible, vaccination should be performed during winter season when under proper conditions of cold storage the vaccine keeps potent from three weeks to two months. High temperature or agitation causes deterioration of the vaccine. During summer the period of validity of vaccine should not exceed from 7 to 10 days from date of despatch.

Another practical and economical method of control is proper sanitary herd management. The reactors should be segregated and non-reactors should be tested after frequent intervals. Every care should be taken to prevent infection gaining entrance into a normal herd. All the new animals added to a herd should be negative to agglutination test used for diagnosing this disease. Animals purchased from cattle fairs and other markets should always be tested before admission to the herd. (H.K.L.)

INDIAN FORESTS AND INDUSTRIAL DEVELOPMENT*

AMONG primitive peoples wood and other forest products serve a wide range of domestic needs and are indispensable to their methods of life. The industrial and commercial nations of the world have developed numberless substitutes for wood but have not thereby decreased their consumption of it or become less dependent on forests. New demands have arisen that utilize the products of forests in a multitude of ways unknown to primitive man. Directly or indirectly every aspect of modern life would be handicapped if the woods, resins and other products of forests become scarce or unduly expensive. Some of the numerous ways in which these products help, are in the growing and packing of foods, the manufacture of plastics, clothing and paper, the construction of means of transport and communications and the making of a wide range of items of less essential nature.

An age-old engineering material

Think of the use of wood for structural purposes in all its myriad forms. It has carried loads, transported foods, framed and sheathed buildings and sheltered the builder. The use of wood as railway sleepers, while relatively small in volume, is of tremendous importance. It is hard to conceive of the railway transportation system having reached into all the corners of the globe except upon a wood base. This age-old engineering material, wood, has delivered unusually valuable service to man.

In India, the regions of the Himalayas and other mountain tracts well-supplied with rainfall, originally supported vast forests of a quality as good as in any other continent. This heritage has been freely used; much of it has been wasted, but fortunately a good part of it still remains. About one-sixth of India's land area is still covered with forests. An intelligent consideration of the wise use, conservation and protection of these essential materials is the duty of every Indian. This has been forcefully brought to our notice twice during recent weeks. The Agriculture Secretary of the Indian Government speaking at the meeting of the Central Board on Forest Utilization at Dehra Dun, said:

> 'India's forest policy in the past appears to have been static in character; now it must be more dynamic. The use of our forest resources for the industrial development of our country must be given a prominent place in our future programme of forest development'.

Later Shri Jairamdas Doulatram, the Agriculture Minister of the Government of India in his convocation address at the Indian Forest College stressed the same point:

> 'We must make our forests the hand-maid of agriculture and industry: They must protect our agriculture against the consequences of floods and other elemental forces of nature. Our forests must subserve and feed our industries with the raw materials that they need. The day should soon come when every square mile of Indian forests is exploited to its fullest extent in the service of agriculture and industry'.

Against this background, it would be useful to briefly survey the work done at the Indian Forest Research Institute, Dehra Dun, and look for a few useful lines of development for the future.

Silviculture

It is the object of forest management to give to man full possession and control of the forest. Forest management in its broad sense is a long and exacting process which involves the investment of considerable capital. A

*A Review of Research Schemes at Forest Research Institute, Dehra Dun.

forest is more than a mere group of trees. It includes not only the trees but also the soil, the undergrowth and reproduction as also game, livestock, insects and men that resort to it. The component parts of a forest bear the same relation to each other as do the individuals in a village or town. The trees are mutually dependent against wind-throw, and snow-break and the close canopy of the trees allows the formation of that essential complex compound 'humus', which is used for maintaining soil fertility. At the same time the trees compete for food, moisture and light. So intensive is the struggle for existence in forest life that 100 trees on an acre at maturity, may be the final survivals of 10,000 seedlings that started life.

A forest is the product of soil and climate. Silviculture is the science of biological response to environment utilized for growing trees and forest crops, and affording them protection till maturity.

The work of the silviculturist is therefore of great value not only to the forest departments of Indian provinces and States, but also to the owners of private forests, industries using wood, and land-owners or corporations engaged in tree planting.

Closely linked with silviculture are two subjects of universal interest—land use and erosion. India is already alive to the dangers of the latter. Valuable information has been collated and published on some aspects of erosion control, including effects of control of grazing, stocking with better grasses and contour trenching.

Fuel

The largest use of wood, fuel, is the most primitive, the most wasteful and among the most important. Considerable work has been done on collecting information about suitable species, and some material has been published on the silviculture of village and fuel plantation.

Death-dealing insects

An epidemic, which a little over 30 years ago destroyed 60 lakhs of trees in Central and North India and caused the nation a loss running into several crores of rupees, was due to an insect, the sal borer; the spike disease of sandal in Coorg, Madras, and Mysore is estimated to have killed sandal trees valued at over Rs. 2 crores. These figures give a measure of the destructive power of insects on forest trees and forest products.

The entomologist aims to check or prevent such losses. It is for him to ascertain what groups of insects are most injurious to particular trees or timber, to study their life-history and rate of development, and determine suitable and practical methods of preventing their increase. The control schemes devised for the sal heartwood boring insect, have enabled the forest departments of the States and the provinces, to adopt standard measures at insignificant costs. It is now possible to predict with confidence the periods of epidemics and the precautionary measures to be taken.

The entomologist has also proved that the high rate of mortality among sandal trees is due to a disease caused by a virus which is carried by a sap-sucking insect. New outbreaks have been suppressed and the spread of the disease checked.

To a casual observer the entomologist has no connection with forest products and their utilization in industry. It is not however generally known, that industries concerned with the manufacture of furniture, packing cases, plywood, matches and sports goods have to guard against special insect pests. A few examples will illustrate the importance of the subject. (1) As a result of measures taken, the plywood industry in Assam to-day produces tea chests and panels that leave the factories entirely free from the defects due to a certain type of beetles. (2) Advice on mill hygiene given to the manufacturers of packing cases and matches in Bengal, the Central Provinces and Bombay has eliminated complaints of defective finish. (3) Rejections of pith hats by the Army because of the damage by an insect have ceased as a result of suitable remedies taken. (4) Complaints from the Army regarding solid bamboos used as lances and from the police about their lathis have ceased, because of suitable preventives against damage by an insect which feeds on the sap of bamboos. (5) Frequent and serious interruptions on the high voltage transmission cables caused by swarms of flies in the United Provinces have been successfully prevented.

The entomologist lists more than 100 species of white ants and the prevention of damage

by them is a widespread problem. The species vary widely in their habits and before effective control measures can be confidently prescribed, thorough biological studies are needed. Exploratory work in this connection has been carried out at the Research Institute during the last three years. This must now be followed up with a comprehensive survey of these destructive insects, their biology and control measures.

2½ lakh plant specimens

The herbarium of the Indian Forest Research Institute comprises over 2½ lakh plant specimens representing the flora of all parts of the world, but more specially of India. It forms the basis of all fundamental research in systematic botany, in describing plants new to science and in bringing to light the little known plants from the myriad types growing in the forests. When dealing with plant produce, whether timber or other, it is of the greatest importance to correlate with the several items of research, the correct identity of the species concerned.

To take only one example: the importance of grasses is well-recognized, not only as raw material for making paper and essential oils but also as indicators of soil and forest types.

Utilization of forest products

The variety and abundance of Indian economic forest products (technically called 'minor forest products') is perhaps unequalled in any other similar area in the world. Over 3,000 species of plants besides a large number of animal products play an important role in the rural and industrial economy of the nation. Essential oils, resins and gums, fatty oils and fats, medicinal plants, canes, bamboos, grasses, other products such as honey and lac, and materials for packing and wrapping are the means of livelihood for millions of inhabitants near the forest. Many of these 'minor products' valued at crores of rupees form the raw material for a number of modern industries, and some are also valuable items of international trade.

In 1939-40 raw materials worth about Rs. 4 crores were exported. In addition there are many other items, which if properly investigated and utilized, will improve the economic position of the country. To cite one example: till about five years ago 35 lakhs of maunds of tamarind seed were thrown away as waste; to-day nearly six lakh maunds of seed kernels are being turned into a product similar to starch for sizing purposes. Investigations also show that tamarind seed kernels are by far the cheapest source of a 'pectin', which is utilized in the preparation of jams and jellies. And so the quest for substitutes proceeds apace at a tempo quickened by the necessities of a free nation awaiting great industrial development. It is a quest which may produce results even more astonishing than those already achieved, not only in reference to the materials and substitutes available in India's forests, but also in reference to the revolution that may be effected in the economics of our country. The ready availability of a wealth of raw materials in India might well act as an incentive to the successful development of many new industries.

Two other examples will illustrate the vast potentialities for the exploitation of forest products other than timber.

Camphor

The most important natural source of camphor, supplying 75 per cent of the world's demand, is a plant which has failed as a commercial proposition in India. The manufacture of synthetic camphor has also proved uneconomical. Experiments conducted on the cultivation of a little known shrubby plant in India, show that it yields camphor which is identical in all respects to the imported commodity. This plant can be harvested within six months of its sowing. India's annual imports of camphor average 20,00,000 lb.; with the rapid industrialization of the country, the demand for camphor will increase rapidly.

Soil stabilization

Four years ago experiments conducted at the Forest Research Institute revealed the property of certain forest products in bringing about the stabilization of soil and their binding property for sand. Think of the lasting benefits of this research to the millions of India's village population, whose mud houses are every year washed away and where village roads become impassable during the monsoon. If further experiments on this

pakki matti are successful, the teeming poor of India will have, at an insignificant cost, mud houses that will stand up against heavy rains, floors that will match cement ones, and roads that will be impervious to the ravages of the rains.

Wood for aircraft and ship-building

India produces about 4,000 different timbers, not all of which can be exploited economically. The development of forest industries therefore depends in a large measure upon the science of wood technology which deals with the internal structure of different timbers and recommends their most suitable uses. Two examples will illustrate how wood technology facilitates the scientific and efficient management of industries. The spruce of North America is the most important timber in the world for aircraft construction. During the last two wars this timber was practically unavailable in India. Field surveys which were started in the hill forests of the Punjab and the United Provinces showed that aircraft quality timber is available in this country in the Indian varieties of spruce and fir.

A special type of South American timber used for certain parts of ships was lost to India during the last war and the prices rocketted to Rs. 500 per c. ft. against a normal of Rs. 15. Surveys made in Bombay and Madras revealed a suitable substitute known as the 'red cutch' which is now available at Rs. 10 to 15 per c. ft. and is being used by most of the ship-building firms in Bombay.

Teak, an increasingly expensive raw material, has for centuries been used for ship-building. There is no reason why attempts should not be made to find substitutes for teak at least for the non-vital parts of the ships.

Wood seasoning

Wood seasoning is intimately connected with the development of wood-working industries and the utilization of wood in any form for wooden poles, railway sleepers and carriages, for furniture and cabinet making, packing case manufacture, shuttles, bobbins, sports goods and bent wood articles, plywood and laminated wood, for rifle furniture and the various ordnance stores. In the past Indian timbers have suffered against imported varieties because of a lack of proper seasoning of the wood before use.

A great deal of work was carried out on this subject during the war, when supplies of foreign timber were suddenly lost to India. Among the important investigations made are: the suitability of Indian timbers for textile and jute mill accessories such as bobbins, shuttles and for pencils. At present the latter industry depends largely upon imported timber.

For the manufacture of handles of umbrellas and walking sticks, sports goods and bent-wood furniture, it is necessary to investigate the bending properties of Indian woods. Some work in this connection has already been done but considerable progress has still to be made. The importance of this investigation has increased considerably on account of the partition of the country; sports goods manufacture has for long been concentrated at Sialkot, which is now in Pakistan.

Wood to relieve steel shortage

Till recently wood has been used mostly in the natural state with all its attendant defects. Recent researches have been directed towards improving the properties of wood so that it can withstand the competition from other powerful competitors. The subject has, as a result of the war, assumed enormous importance because of an overall shortage of steel. As against India's minimum annual requirements of two million tons of steel the availabilities are reported to be only about a million tons. Either the country's industrial development and its building programme are to be hampered and delayed or 'treated' wood has to replace steel in many directions. The work on this subject is, therefore, of immediate importance to the railways, the ship-building and aircraft industries, the telephone, telegraph and electricity industry, the chemical, plywood, adhesives, sports goods, textile and all other industries utilizing wood. In this endeavour is involved Rs. 15 crores worth of timber per annum.

Railway sleepers

The foundations of wood preservation research in India were laid about 30 years ago; the first commercial wood-treating plant

which was started at Dhilwan in the Punjab has treated over 4 million railway sleepers. There are at present six creosoting and some ascu plants in operation in India, which impregnate several lakhs of cubic feet of timber annually against decay and termites' attack.

The total demand for railway sleepers during the next few years is estimated at 39 lakhs of broad gauge and 25 lakhs of metre gauge sleepers costing about Rs. 5 crores per annum. With the decrease in the available supplies of naturally durable sleepers, the more extensive use of treated sleepers has become imperative and the Government of India are reported to be working on a scheme of opening many more centres for the treatment of Indian wood.

Another important field of timber utilization in which wood preservation plays an important part is that of marine structures. Several lakhs of cubic feet of timber are used in Indian harbours and trials are in progress to test the efficiency and economy of different types of preservative treatment.

Adhesives

Casein, which is imported from abroad, is an adhesive used in plywood manufacture. During the war its price rose from about Rs. 300 to Rs. 4,000 and to-day it is Rs. 6,000 per ton. Other sources of protein from indigenous materials for adhesives have been explored with encouraging results. They have been developed from groundnut, other seed cakes, and from a waste of starch; the latest is the development of a weather-resistant adhesive from cashewnut shell oil, which is available in India.

Laminated wood

Growth defects in timber, like knots are localized and often form the weakest part of a wooden structure when solid wood is used. Such failures can be reduced by dividing wood into thin sheets or 'lamellae' which are again glued together so that the localized defects are distributed. By using higher pressure during lamination, compregnated wood is produced. Laminated and compregnated wood can be used for aeroplane propellers, bearings, textile mill auxiliaries, electrical insulators and sports goods.

One hundred and fifty million square feet costing Rs. 4 crores is the estimated plywood demand in India. Although this industry developed greatly during the war, it is still in its infancy, requiring constant research and guidance. The suitability of various Indian species of timber for the manufacture of plywood has been investigated, and with the installation of a new composite wood plant, it should be possible to devise methods of utilizing species of Indian timber hitherto found unsuitable.

Cellulose

Wood, bamboos and grasses are important sources of celluclose, one of the basic requirements of a large group of chemical products now coming into prominence. They include rayon, cellulose and allied plastics, and nitrocellulose, the principal ingredient of certain explosives.

In modern civilization, paper, boards and celluose products play an important role. The development of the arts, science, agriculture, industry and commerce, the governance of countries, in fact almost every phase of human activity directed towards cultural progress, requires the use of paper pulp (cellulose) and boards. A number of the necessities and amenities of modern life is supplied directly or indirectly through cellulose as the basic material, e.g. artificial silk and staple, fibre, paper, textiles, plastic materials, photographic films and foils, explosives, lacquers and varnish, power alcohol and constructional boards.

We are all familiar with the excellence of rayon, which has enabled women of moderate incomes to dress almost as smartly as their more affluent sisters. But there was never any reason why the story should stop there, and it has not. It has added in the last few years chapter to chapter to the great story of the exploitation of the forests, to suit the increasing demands of modern civilization.

Paper

Paper is a felted sheet of plant fibres. Limited quantities of hand-made paper are still made from grasses, flax, straw and other vegetable fibres. Much high-grade paper is still made from rags and other relatively expensive materials. Cheap and abundant

newsprint and wrapping papers are, however, the result of processes, that turn logs of wood into endless strips of paper, in the form of rolls having any desired width and weight.

The present potential productive capacity of 15 paper mills in India is estimated to be about 110,000 tons per annum. In 1937-38 the total imports of paper and boards from abroad amounted to about 145,000 tons. The present *per capita* consumption of papers and boards in India may be taken to roughly about 1·4 lb. as compared to 150 lb. in the U.K., 175 lb. in Canada and over 300 lb. in the U.S.A. Cheap and low-grade writing and printing paper will therefore be required in enormous quantities, for the spread of literacy among the masses; for too long has India remained indifferent to the spread of mass education.

Newsprint

The acute famine of newsprint during the second world war has amply demonstrated the necessity of making the country, as soon as possible, independent of foreign imports of newsprint. It is satisfactory, therefore, to learn that recently, bulk quantities of ground-wood pulp from the paper mulberry and bleached bamboo pulp were prepared at the Forest Research Institute and converted in one of the Indian mills into reels of 'mechanical' paper. The printing trials on a high speed rotary press have proved satisfactory. In view of the great difficulties of utilizing coniferous woods which are most suitable for the production of mechanical pulp, investigations are in progress on the possibility of utilizing soft woods of the broad-leaf species.

The demand for paper of all kinds is bound to increase in the coming years and investigations on the possibilities of manufacturing various types of paper and the suitability of particular raw materials for the purpose are very necessary. To give a few examples of India's requirements: grease-proof papers, high wet strength papers, cable insulation papers, water-proof papers, surgical cotton and boards for heat and sound insulation, panelling, furniture, partitions and for the bodies of vehicles. It may be possible to manufacture the latter from saw mill and forest wastes, jungle grasses, and from hard wood which, at present, finds no use.

Technical training

A proposal is under consideration in the Research Institute, to organize regular and advanced courses of training in pulp and paper technology for a sufficient number of young men, who would in due course be able to fill in supervisory and managerial posts in paper mills. The paper industry has so far depended on foreign experts to man responsible positions in the mills and the admission of Indian students in well-known technological foreign institutions has been extremely difficult. Training within the country on advanced standards, is preferable to the more expensive method of sending students abroad. The present proposal is to train about 15 students per year but the facilities will have to be expanded greatly to meet the growing demand for trained technical personnel.

The above survey indicates where India stands *vis-a-vis* the other countries of the world in regard to the utilization of her forest wealth. The comparison with some foreign countries especially those which are in the vanguard of industrial progress, reveals the tremendous gap between them and India in respect of forest utilization. However, it is important to bear in mind that given proper direction, the utilization of India's forest wealth can develop into among the most promising industries of the country. With an Indian Minister in charge of Agriculture, an Indian Secretary in charge of the Department, and for the first time since the inception of Forest Research Institute, an Indian at the head of the Research Institute, planning for the growing needs of the country can be on more comprehensively national lines than ever in the past. (*P.I.B.*)

CATTLE DISEASES IN BOMBAY PROVINCE*

A DIAGNOSTIC survey of tuberculosis, Johne's disease and contagious abortion has been conducted and all the three diseases have been found to be widely prevalent in the province.

The incidence of tuberculosis has been regarded to be fairly high and is found to be higher in dairies than the cattle-breeding institutions. In 1934-35, its incidence was as high as 20·9 per cent. In some places the affected animals were segregated and other precautions were also taken.

Contagious abortion has been found to be widely prevalent in several districts. This disease has been confirmed by agglutination test. Brucella organisms in pure cultures were isolated for the first time in India in synovial fluid collected from a cow suffering from synovitis of the knee. Calfhood vaccination against the disease has been performed with encouraging results. Treatment in early years with 'Contramine' failed but 'Yatern abortion vaccine' and 'Prontosil' gave satisfactory results. It was noted that majority of cases aborted repeatedly at certain institutes and villages. Abortion in certain cases was also found to be due to non-specific causes and was controlled by feeding 'Churn' of I.C.I.

In 1940-41 a virus-absorbed aluminium hydroxide vaccine was prepared under the direction of Indian Veterinary Research Institute, Mukteswar, for use against foot-and-mouth disease. Immunity conferred by it was found to be effective for one month.

In early years work on rinderpest was done and as a result of that work vaccination with GTV vaccine has been adopted as a routine measure. On tests performed over several years the vaccine has been found to confer immunity for more than five years. A reduction in the milk yield of 46 per cent was observed but it returned to normal gradually. Large number of animals have been tested against Johne's disease.

* Summary of the work done by the Disease Investigation Officer, Bombay, during 1932-47.

Trypnosomiasis was investigated in early years and Naganol was found to be effective as a curative and preventive. Outbreaks of Bovine surra were successfully controlled with tarter emetic treatment. 'Anthiomaline' was found to be better because it can be used both intramuscularly and intravenously. DDT has been successfully used for fly control.

Theileriasis among calves was investigated with special reference to identity of the causative parasite and the transmitting tick and control measures were undertaken by making tick-free paddocks.

A helminthic survey has also been carried out and all important genera of helminths have been found to be present in this province. A good deal of attention has been paid to the nasal granuloma and verminous pneumonia. The former has been treated successfully with tarter emetic and 'Antimosin'. The disease has been successfully controlled by the above treatment and by destroying snails in water tanks with copper sulphate.

In calves, sheep and goats outbreaks of diarrhoea and debility were attributed to *H. contortus* and Oesophagostomes.

Heavy tick infestations among cattle were investigated and Cooper's cattle dip and Tick grease against ticks were recommended. The extent of the infestation was recorded.

Night blindness was observed in cattle and was attributed to feeding on cotton seed. Feeding of green fodder cured the affection.

Various species of biting flies were collected from various places in the Bombay Presidency and were later identified by the Indian Veterinary Research Institute, Mukteswar.

Dermititis in young buffaloes has been treated with encouraging results by the administration of sterile sea-water.

Cases of sterility and late maturity were observed in North Kanara and East Khandesh Districts and were attributed to malnutrition.

In 1943-44 it was observed that dairy cattle came on heat when they were fed on yeast. (I.C.A.R.)

BEE RESEARCH

By COLIN G. BUTLER

ALTHOUGH honey-bees have been kept in apiaries for hundreds of years and have roused the interest and active curiosity of many people, serious bee research, like so many other branches of biological research, really only commenced about thirty years ago. Bee research has, perhaps, been unique in that it has behind it a great mass of data, accumulated throughout the centuries, relating to the behaviour, anatomy and management of honey-bees. Much of this information has been found to be of great value, but fifteen or twenty years have had to be devoted primarily to an attempt to sort out the good from the bad, the true from the false, and to discover the fundamental facts underlying the proven practices of successful bee-keepers. This has been a necessary prologue (and it must be realized that it is not yet fully completed) to the work which will, I am confident, lead to great advances in bee culture during the next quarter of a century. It also helps to explain why more rapid advances have not yet been made. We stand upon the threshold of a new era of bee research and bee-keeping now that much of both the good and the bad in the bee-keeping practices of the past has been disclosed and now that it is realized that the honey-bee has an indispensable part to play as a pollinating agent rather than as a mere producer of honey and wax.

Although I do not wish to be thought to be making any prophecies, I should like to discuss some of the current trends of thought amongst bee research workers and some of those lines of investigation which appear to be of particular interest and promise.

Artificial insemination

The development of first-class honey-producing strains of bees has, in the past, been seriously hampered, indeed, rendered almost impossible in most places, by the absence of any known method of securing the insemination of a given virgin queen bee by a selected drone of known parentage. As long ago as 1789 Huber discovered that queen honey-bees mate outside the hive and free in the air. Ever since then sporadic attempts have been made to cause queens mate in some confined space, or tethered, or in some other way more or less under control. Indeed, Huber himself describes how he tried, without success, to inseminate a queen instrumentally at the suggestion of his friend Bonnet, whom, it is said, suggested to him that 'it would be suitable to try to fecundate a virgin queen artificially by introducing within the vagina, at the end of a hair pencil, a little of the prolific liquid of the male'. In 1923 Quinn reported that he had succeeded in inseminating a queen by opposing to her genitalia the genitalia of a drone in such a manner that, on causing the latter to ejaculate by applying pressure to his abdomen, his penis entered the vagina of the queen and remained there, much as in the case of natural mating. This technique of 'hand-mating', as it has been called, was practised with some degree of success by various workers, particularly by Quinn's grandson, Harry Laidlaw, but was proved to be unreliable and has been discarded. In 1926, however, Watson demonstrated convincingly that it is possible to inseminate a queen by the use of a small glass syringe but, although Watson himself, and others, particularly Nolan, obtained some promising results with this technique and were able to carry out certain breeding experiments, it too was found to be unreliable. Only a small percentage of the queens operated upon produced fertile eggs, and then only sparingly, and after a long period.

It was not until about 1944, when Laidlaw published details of his discovery of a hitherto

overlooked valve-fold in the genitalia of the queen, that further progress along this line became possible. From that time, progress has been rapid. Thanks to the work of Mackensen and Roberts in the U.S.A. who have developed a technique whereby semen from the drone is passed beyond the valve-fold and directly into the median oviduct of the queen, it is now possible to produce a fertile queen by means of artificial or, more correctly speaking, instrumental insemination, which is in every way as good as a naturally mated queen. Such a queen is perfectly capable of heading a large honey-producing colony for a full year or more with complete success. Not only does this technique enable us to produce queens, drones, and worker bees of known parentage, but it also has the important advantage that such fertile queens can be produced easily and regardless of weather conditions, whenever virgin queens and drones can be obtained. Furthermore, the great majority of the fertile queens inseminated by means of the latest elaboration of this technique commence to lay within ten or twelve days of emergence as adult insects. Indeed, so successful is this method of producing fertile queens when the necessary apparatus and skill in its use are available that the Federal Research Workers in the U.S.A. are believed to have abandoned completely their queen-mating apiaries and now rely entirely upon queens inseminated instrumentally to head the hundreds of colonies employed in work on honey production, disease resistance, etc. at their various strategically placed Bee Culture Laboratories. None the less, it will be obvious that very delicate apparatus, a good binocular microscope, and other laboratory facilities are necessary, as well as a good deal of practical experience before one can hope to inseminate queens successfully. For these and other reasons, I think there is no likelihood of this technique being adopted by many of our commercial bee-keepers thus rendering their mating apiaries redundant. I am quite certain, however, that this technique, properly applied by skilled people working on a definite programme of strain improvement, can result in a few years in very greatly improved strains of bees being available to bee-keepers in this country. It is my view that bee-breeding and strain improvement is and is likely to remain, primarily a matter for research centres. For the good of the industry, and so that the most rapid progress possible may be made, it is greatly to be hoped that all centres where work of this kind is taken up will keep in very close touch with one another and work upon an agreed and carefully coordinated programme.

Breeding policy

I hope that it will be possible during the next two or three years to bring together at various centres a collection of perhaps a dozen of the world's best honey-producing strains of bees. From the best of these strains a number of lines will have to be bred and most carefully maintained by means of artificial insemination.

Since it is already known that the inbreeding necessary to purify these lines will lead to a serious reduction in the viability of the eggs and young larvae produced by the queens of these lines, it will be necessary to mate a drone of one line of strain with a queen of another line of the same strain in order to produce a queen of this strain for use in a honey-producing colony. It will, therefore, be desirable to develop and maintain at least half-a-dozen of each strain selected. Once a number of inbred lines of various strains have been developed it will be possible to embark upon a definite programme of work in an endeavour to develop better strains and to study such matters as hybrid vigour. It is very probable, indeed, that a hybrid worker bee produced by crossing an inbred line of one strain with an inbred line of another strain will prove to be a better honey gatherer than workers from either of the strains. Some hybrids will, of course, be much better than others and, once the most desirable crosses have been discovered, they can be produced as desired, provided, of course, that the parent strains are maintained. If we desire to make use of these hybrids the inbred strains will have to be maintained indefinitely and arrangements made whereby the hybrids can be produced and distributed in numbers. It may, for instance, be possible to obtain the active cooperation of our commercial bee-keepers and to supply them with breeder queens and drone-producing colonies from which they can rear queens which will produce the desired hybrid workers. It seems clear

to me that research workers, honey farmers, queen breeders, and amateur bee-keepers will have to get together and agree upon some coordinated plan of work, if we are to obtain the very real advantages which this new technique of instrumental insemination offers to us.

Bees as pollinators

It is my considered opinion that this new technique of artificial insemination which allows of the production of first-class queens is one of the most important advances so far made in research work on the improvement of strains of bees, not only for honey production but also for wax production, and also for that still more important purpose, the pollination of the flowers of specific seed crops. There seems to be little doubt, for instance, that some strains of honey-bees tend to visit red clover certainly for pollen, and probably also for nectar, much more frequently than do bees of other strains of the same race. It should now be possible, and it is undoubtedly desirable, that strains of bees should be selected and developed for such definite purposes as the pollination of red clover or alfalfa. We may, perhaps, also be able to select definite strains for the production of clover, heather, or any other definite kind of honey. If artificial insemination and controlled hybridism can do for bee-keeping anything approaching what they have already done for animal and plant breeding, they are surely worthy of our very first efforts.

Comb space

There is one aspect of such a programme of stock improvement which will require most careful consideration. All the really first-class honey-producing strains of bees that I have so far come across, both in Europe and in North America, have been very prolific breeders and require adequate comb space in which to develop their large brood nests. Unless this important fact is fully appreciated, by these bee-keepers who wish to make use of these strains of bees, which, I hope, will soon become available to all, many of them will certainly not take full advantage of the potentialities of these strains and, even in good districts in good seasons, will not obtain the large crops of honey that are possible. It would seem, therefore, that it will be necessary to include in any stock improvement programme a scheme whereby bee-keepers may learn how to obtain the best results from prolific queens and how to handle much larger colonies than those that they have hitherto been accustomed to manipulate. Possibly, demonstration apiaries maintained by bee-keeping instructors may help to solve this problem. It is of little benefit to make queens of really good strains available unless the purchasers of such stock know how to make proper use of them.

Disease resistance

In the U.S.A., Dr O. W. Park, Mr. Frank Pellett and other workers, have clearly demonstrated that certain strains of bees of Italian and other races show a remarkable degree of 'resistance' to infection with American Foul Brood Disease. It has been shown that queens of these so-called 'resistant' strains produce workers that are excellent house-cleaners and very quickly clear out any larvae, whether in the ropy or scale stage that have died in the hive of A.F.B., or have been introduced in order to test the 'resistance' of their colonies experimentally. These bees do not possess resistance to this disease in the sense that their larvae are immune to it; their larvae can become infected with *Bacillus larvae* (the bacterium responsible for A.F.B.) and die, but the strongly developed house-cleaning propensities of these strains of bees result in the diseased larvae being thrown out at an early stage and the chance of spread of the disease within the colony is lessened. Unfortunately, however promising this work sounds, those strains of bees that have been found, so far, to possess a high degree of 'resistance' to A.F.B. are both bad tempered and poor honey producers. Perhaps even more serious is the fact, that in some cases at least, they appear to be particularly prone to attack by European Foul Brood. I am convinced that a great deal of careful breeding work and testing of the resulting bees under various climatic conditions still remains to be carried out before we can expect to make any really useful advance in the control of A.F.B. by the use of strains of bees that show 'resistance' to this disease. Now that 'resistance' to

A.F.B. has been clearly demonstrated to be a genetical, an hereditary character, it will probably be wiser and more profitabe to search for 'resistance' amongst some of our more promising honey-producing strains of bees. Such 'resistance' must be present to some degree and only needs searching out. It is better to do this than to attempt to tackle the problem the other way, by setting out to improve the honey-producing capabilities of one of the 'resistant' strains already available. A considerable amount of time has already been spent in attempts to improve the honey-producing capabilities, and the temper of bees of some of these strains, without any very promising results having been achieved. This is, of course, yet another problem in which the technique of artificial insemination is likely to prove of very great value.

Disease control

Other attempts to gain control over American Foul Brood have been made by feeding various drugs of the sulphonamide group in syrup, both to colonies of bees infected with this disease and also to colonies that have been exposed to infection. Unfortunately, what I regard as very rash and hasty claims for the elimination of A.F.B. from colonies of bees by the use of such sulphonamides as sulphathiaozole have been made by a number of people both in the U.S.A. and in this country. Much publicity, which I regard as being very premature, has been given to this method of eliminating the disease from a colony of bees. During the past few years we have been carrying out, at Rothamstead, and, latterly, at various widely scattered centres, a series of experiments designed to test such important things as the relative efficiency of various sulpha drugs; methods of applying these drugs to infected colonies; the dosage required under different circumstances, etc. As a result of these trials we already know, quite definitely, that, under favourable conditions, the majority of colonies that are infected with A.F.B. will respond in a satisfactory manner to treatment with various sulpha drugs. But we also know, equally definitely, that some colonies that are infected with this disease will not, apparently, respond to treatment at all. The reason, or reasons, for this are at present unknown. In yet other cases in which, after treatment has been completed, all traces of the disease have disappeared, it has reappeared again some weeks later.

So far, we have no satisfactory data to show just how these drugs work when they are successfully applied to a colony of bees suffering from A.F.B. The diseased larvae, whether they are still in the 'ropy' stage or have dried up into 'scales' just disappear, first from the centres of two or three combs in the brood-nest, next, as the size of the brood-nest increases, throughout these two or three combs, then from the centres of the next couple of combs, and so on, until not a scale or dead larva remains anywhere in the brood-chamber. It is, of course, the bees themselves that do this job of house-cleaning, being stimulated to do so, apparently, by the sulpha drug, which appears to increase their energy. But, although the bees themselves throw out the diseased larvae, many millions of spores of *Bacillus larvae* must still remain in the hive, hidden in the honey, wax, etc. ready to cause trouble later on. It has also been found that these drugs do not prevent germination and growth of the spores of this bacterium in vitro, nor do they inhibit the formation of spores by this organism. It appears difficult, therefore, to explain some of the promising (I would not care to call them anything more than this) results that have been obtained with these drugs in the apiary. Dr Sturtevant, the great American authority on brood diseases of the honey-bee, has suggested that germination of the spores of *Bacillus larvae*, when they have been fed by a nurse bee to a larvae with its food, is retarded for a few hours, and this time is sufficient to carry the larva over the very limited period of its life during which infection can take place. Whether or not this is the true explanation, it is becoming increasingly clear that this method of control is certainly not reliable as it stands and that one cannot, under present circumstances, feel justified in recommending the use of these drugs to bee-keepers. Indeed, particularly as the treatment is rather expensive, it is doubtful whether it is ever likely to prove to be that boon to bee-keepers which early statements by its sponsors led us to hope might be the case. In the present state of our knowledge, it would, in my opinion, be

a very grave mistake, to allow treatment of an infected colony with a sulpha drug as an alternative to total destruction, particularly in England and Wales where destruction is now compulsory. Where a policy of destruction of all infected bees and combs, and disinfection of the hives has been energetically and faithfully carried out during the last few years, such a high degree of control over this disease has been obtained that it would be foolish to run the risk of losing ground in any attempt to save the lives of a few colonies of bees.—Reproduced from *Scottish Agriculture*, January 1948.

NEW VARIETY OF COTTON

A NEW variety of cotton known as Mysore-American V. has been evolved by crossing Co. 2 (a Cambodia pure strain) which is much superior to local Doddahatti grown in the northern and central tracts of the Mysore State since 1850.

M.A.V. cotton grows well both under irrigation and rain-fed conditions. It is fairly resistant to Red Leaf Disease unlike Doddahatti which is very susceptible to it. The plants are characterized by broad leaves and big bolls which open well. Its staple length is $1\frac{1}{8}$ in. and its ginning outturn goes up to 35 per cent. Its cotton spins up to 36's Highest Standard Warp Counts.

The yield varies with the type of cultivation from 400 to 1,350 lb. of kapas per acre.

Home Gleanings

PETHA : ITS CULTIVATION AND ECONOMIC USES

By B. N. AGNIHOTRI

PETHA (botanical name—*benincasa cerifera*), a popular fruit since time immemorial, has been cultivated in almost every part of India under different local names such as *petha*, *chal kurma*, *gol-kaddu*, *kumrá*, *kudimah*, *kondha*, *phuthia*, *khabha*, *bhunja*, etc. The English equivalent of *petha* is white gourd melon.

History

Even of late there was a belief that the plant did never exist in a wild state. This has now been found to be incorrect. In fact, this erroneous belief appears to be due to confusion caused by different botanical names for the wild growing species by various workers.

According to DeCandole it is a native of Japan and Java. The cultivation of *petha* in China dates from the remotest antiquity. It is reported to have been cultivated in some parts of Europe but its cultivation was given up later on. It is difficult to say as to when *petha* cultivation started in India, but there is reason to believe that it must have been here for a very long time.

Uses

The fruit is used as a vegetable and forms also an ingredient in curries, but is rather watery and tasteless, if cooked alone. The fruit is largely used for making confection which consists of the pieces of this gourd coated with sugar. The fruit has been very much prized because of its medicinal properties. According to Watt the fruit possesses alternative and styptic properties and is popularly known as a valuable anti-mercurial. It is also said to have cooling effect. Owing to its tonic*, nutritive and diuretic value it is a specific for haemoptysis and other haemorrhages from internal organs. According to the authors of old Sanskrit works it is also useful in insanity and other nervous diseases: the fresh juice being given either with sugar or as an adjunct to other medicines. Watt further quotes a number of authorities who recommend it as a medicine for various other ailments such as pthisis in the first stage (as a base to administer pearl shells), pulmonary consumption, piles and dyspepsia, syphilitic erruptions (as vapour bath) and diabetes.

Description

The plant, an extensive climber with trailing habit, belongs to the natural order Cucurbitaceae sub-family Cucurmerineae. It is an annual with a large pumpkin-like fruit which is fleshy, oblong or ovoid cylindrical one to one-and-a-half feet, hairy and bright green when young but becoming smooth when ripe and covered with bluish-white, waxy bloom.

Cultivation

It is, as a rule, found growing on waste heaps in the vicinity of the village sites or near the dwelling places; while under cultivation, it is allowed to ramble over the thatched roofs but in some localities it is commonly grown on the ground without support.

*Moisture per cent 96·0	Protein per cent 0·4	Fat (Ether extract) per cent 0·1
Mineral matter per cent 0·3	Fibre per cent Nil	Carbohydrates per cent 3·2
Ca per cent 0·03	P per cent 0·02	Fe mgm. per 100 gm. 0·5
		Vitamin B_1 I. U. per 100 gm. 21
Carotene Vitamin A units per 100 gm. Traces	Calories per oz. 4	Vitamin C (mgm. per 100 gm.) 1

* *Health Bull.* No. 23, 1937, Conoor, S. India

Climatic requirements

Petha requires a warm growing season, and is very susceptible to frost. If possible, it should be planted where it may receive full sunlight for major part of the day and where it may be somewhat sheltered from the wind. It is not grown at a height above four thousand feet.

Although *petha* is adapted to a wide range of soil, yet it thrives best on a soil which is well-drained but retentive of moisture, moderately fertile, well-supplied with organic matter and which warms up quickly. Where a long growing season prevails, heavy soil types produce the best yields, but where the growing season is relatively short, light soil types give the best results. Generally a light sandy soil should be selected for its cultivation.

Preparation of the land

As the root system of *petha* is extensive but rather shallow, the upper eight or ten inches of soil should be well-prepared and fertilized by thorough cultivation of three to four ploughings at suitable intervals to give the best results. The intervals should be so arranged as to kill maximum number of weeds. All lumps and clods should be broken up, but it is not necessary to have the soil extremely fine.

Manure

Too rich a soil tends to promote large vine growth and to retard fruiting. About hundred maunds of well-decomposed cow-dung may be sufficient for an acre. This manure is dug into the spot where the seeds are planted but this is never done if the plot was manured for previous crops.

Sowing

The seeds should be sown in patches of three or four seeds eight to ten feet apart, weeding out all but the strongest plant should the whole of the seeds germinate. Sowing may be done in the month of June or July. The amount of seed needed per acre may vary from two to two-and-a-half seers depending upon its size.

Inter-culture

Petha does not require a very great amount of inter-culture. Only light shallow cultivation will do. The ground is left clear of weeds until covered by the vines. After this is accomplished, no further attention is required.

Watering

In the early part of the growing season and when small fruits are beginning to enlarge *petha* requires ample water. Besides usual rains three to four irrigations may have to be given to raise a crop.

Ripening and harvesting

Petha starts maturing in the month of September and continues up to January depending upon the variety and local climatic conditions. The ripe *petha* develops a characteristic tinge which the grower can easily recognize after having some experience. The size of the individual fruit and its weight are other points which are also taken into account for judging its maturity. If allowed to remain on the vine too long after it is mature, the fruit becomes spongy, which renders it useless for use in the preparation of sweetmeat.

It may vary from three hundred to five hundred maunds per acre depending on the local climatic conditions and the cultural operation given.

Pest

The following pests often prove harmful to the fruit.

Red Pumpkin Beetle: The insect damages the crop in two ways. The red beetles come out and eat up the leaves of germinating *petha* which cannot make a good start. The damage by the beetles to leaves, flowers and fruits continues throughout the early growing period.

The beetles lay eggs in the vicinity of the plants. The grubs on hatching often bore into the roots and undergound portion of the stem with the result that the plants soon die.

The young plant in the beginning of their growth should be protected from insects by dusting one of the following insecticides. The dust should be put in a muslin cloth and dusted early in the morning on leaves.

(a) Tobacco dust or kerosene oil ..	½ seer
Ashes	4 seers
(b) Paris green or sodium thiosilicate	½ seer
Ashes	5 seers

Fruit fly: This is a very serious pest of *petha*. About a couple of days after oviposition, the fruits exhibit sign of attack. A white syrupy fluid oozes from the point of puncture. This finally becomes brown.

The flies are active in the field from morning till dusk. They have been observed flying actively about the leaves of plants and quickly alighting on fruit for oviposition. The eggs are deposited in the puncture. The eggs hatch into white larva. Soon after hatching maggots travel towards the core of the fruit which they slowly feed upon.

No practical method of control has been found to be completely satisfactory. It is, however, suggested that the affected fruits, as soon as noticed, should be removed and buried deep into the ground.—Reproduced from *The Indian Food Packer*, February 1948.

MANUFACTURE OF COMPOST

DURING the year 1947-48, 17,45,066 tons of compost were prepared from town and village refuse.

Of these 4,86,080 tons were produced from 566 urban centres and 12,58,986 tons from 27,950 village centres. The Central Government took over supervision of the compost schemes in 1944 and since then there has been a steady progress in the manufacture of compost.

From the trials carried out in different parts of the country it was evident that beneficial results had accrued.

Book Reviews

VETERINARY HELMINTHOLOGY AND ENTOMOLOGY

By H. O. Monnig (Published by Bailliere Cindall and Cox, 7 and 8, Henrietta Street, London, 3rd edition, pp. xviii + 427, with 275 illustrations, including 15 plates, 31s. 6d.).

ZOOLOGISTS in general and parasitologists in particular will doubtless hail the appearance of the third edition of Monnig's book which is a very handy work of reference for students of veterinary helminthology and entomology. The first print of this book appeared only thirteen years ago and the rapidity with which the third edition had to be brought out is a clear indication of its utility and popularity. The book has been written in an easy style and the additional drawings of some helminth ova and gravid segments of common tapeworms of domestic animals have been included. Some figures in the previous editions have been replaced by the author's own drawings. The information contained in Section I forms a very useful introduction to the understanding of most of the implications of veterinary parasitology. Section II is devoted to technique, the knowledge of which is indispensable to a student of parasitology. References have been made to the anthelmintics such as hexachlorethane and phenothiazine and insecticides such as DDT and Gammexane which have been successfully used in recent years. A fairly exhaustive note has been added on phenothiazine. In a short compass of the book of this size it is not expected that all helminth and arthropod parasites so far recorded from domestic animals should have received attention but the important ones have been dealt with. It is, however, felt that reference should have been made to parasites such as *Paryphostomum sufrartyfex*, *Pseudodiscus collinsi*, *Varestrongylus pneumonicus*, *Capillaria bilobata*, *Haemonchus similis* and *Leiperacanthus gallinarum*. *Parafilaria bovicola* and *Protostrongylus rufescens*, do occur in India also. The name and date 'Bhalerao, 1942' have been bracketted against *Cymbiforma indica*, which is evidently an error. Mention should have been made of tobacco-lime dressing against warble-fly larvae. (G.D.B.)

News and Views

AERIAL WAR ON LOCUSTS

By L. ROBERTS

A SYSTEMATIC attack on the locust plague has to-day, more than ever before, become of vital importance in view of the great world shortage of foodstuffs. The danger of this pest has become increasingly clear from official statistics compiled during recent decades. These insatiable insects have destroyed crops to the value of over £83,000,000 (Rs. 110·47 crores) in the countries visited by them.

Although the necessity of a planned, organized campaign against the locust has long been recognized—Britain having taken the lead in this from the start—there was always the difficulty to be overcome that the war against this pest could only be effective if waged on an international basis.

Territory ranging from India to Africa forms, as regards locust migration, one single unit. Swarms which come out of the eggs during the summer monsoon rains in India, migrate in the autumn to Southern Persia and Arabia, while other swarms move simultaneously from Africa to Arabia. Under favourable conditions the next generation moves the following spring from Persia and Arabia to Egypt, Iraq, Palestine, Transjordan and so forth. It is, therefore, obvious that the anti-locust campaign can only be successful, provided it does not call a halt at the various State frontiers.

This international campaign is to be directed from London. In view of the decisions reached at an international conference held in Rome in 1931, of British, French and Italian entomologists, the Imperial Institute of Entomology was converted into a Central Research Station for combating the locust. This Anti-Locust Research Centre acts as headquarters in the war against locusts.

The fundamental principle applied in research is that the outbreak of a locust plague must be destroyed in the breeding stages, that is, before the tendency to swarm sets in and before a mass invasion can take place. The campaign must, therefore, be planned several months in advance on the basis of accurate predictions to enable personnel and material to be transported—often over difficult country—to the 'area of operations'.

At the London Anti-Locust Research Centre, telegraphed reports arrive every other week from all countries, giving information regarding the movements of the locusts; from London accurate forecasts are cabled once a month to the individual governments concerned, regarding imminent developments.

During World War II, a largescale action was taken against the locust in the Middle East and Africa, with the aid of troops and military equipment. This was continued after the war on a non-military basis in Arabia and East Africa. During these operations the use of aircraft proved highly successful.

In a recent issue of the British journal, *Nature*, Dr D. L. Gunn of the London Anti-Locust Research Centre, gave more fresh details concerning the adoption of aircraft in the fight against the locust. This work was carried out under the auspices of the British Colonial Office, supported by the Royal Air Force, the South African Air Force and several other organizations. Particularly valuable research took place at the Chemical Defence Experimental Station of Britain's Ministry of Supply.

The first experiments were not at all encouraging. In 1944, however, Dr J. S. Kennedy checked the results of the anti-locust flights of the British and South African Air Forces and established that the most effective chemical substance used against the locust is Dinitro-Ortho-Cresol (D.N.O.C.). But the apparatus through which the poison was sprayed was heavy and awkward to handle; moreover, the aircraft had to fly so

low that the locusts were often frightened off and managed to escape the descending cloud of poison.

In the light of the experience gained, Dr Kennedy continued his studies at the Porton Research Centre. After lengthy and tedious experiments, the necessary dosage of each substance—D.D.T., Gammexane, Dinitro-Ortho-Cresol, etc.—required to kill one single locust was established, the quantity which should be sprayed to kill an insect either when stationary or in flight was determined and the vulnerability of each individual part of the locust's body was examined.

By August 1945, a detailed plan of action had been worked out. The poison was to be sprayed from an aircraft through a nozzle in drops of uniform size ; the wind was not to be avoided but taken advantage of in an accurate manner to help in spreading the sprayed poison 'rain'.

The anti-locust campaign carried out in Kenya took place under the scientific direction of Dr Gunn. It proved that the method developed at Porton, although accurate in theory had, in fact, certain disadvantages in practice. In the first instance it was found that the poison was not sufficiently strong to make working conditions economic. Further experiments were, therefore, carried out at Porton, and finally, in the summer of 1947, an improved type of apparatus and a better solution were put into use.

These improvements were incorporated in a campaign undertaken on behalf of the International Red Locust Control Organization of Rukwa Tal in south-west Tanganyika. The fluid sprayed from the aircraft, in this instance, was a 20 per cent solution of Dinitro-Ortho-Cresol in a mixture of aromatic petroleum extracts. The results surpassed all expectations. Spraying carried out at the rate of just over 1 gallon per acre resulted in 100 per cent of the insects being killed.

During the last 12 days of the campaign, some 11,000 acres of the most seriously infested areas, were freed of 95 per cent of all locusts, while carefully selected pieces of land, totalling in all about 3,300 acres, were also sprayed in like manner. Dr Gunn has, therefore, arrived at the conclusion that the results of this operation have proved beyond doubt that all the patient research work in Britain has been well worth while.

The locust swarms can, under certain conditions, be attacked successfully from the ground also and suitable machinery is now being built in Britain for this purpose. Thanks to the valuable work being done, the war against this plague, which was even feared in Biblical days, has now entered upon an entirely new phase. (*B.I.S.*)

COVER ILLUSTRATION

Potatoes growing in the Nilgiris.